INFANTS AT RISK: A LONGITUDINAL STUDY OF THE INTERRELATIONSHIPS OF STATE ORGANISATION, MOTHER-INFANT INTERACTION, DEVELOPMENTAL STATUS AND OTHER FACTORS IN PRETERM AND SMALL-FOR-DATES INFANTS

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KEY:

SFD:	Small-for-dates
MDI:	Mental Development Index
NPI:	Neonatal Perception Inventory
RITQ:	Revised Infant Temperament Questionnaire
REM:	Rapid Eye Movements

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ABSTRACT

A longitudinal investigation which was principally exploratory in nature was undertaken in order to elucidate the interrelationships among several factors associated with development in the first year. Ten fullterm appropriate-weight, fourteen preterm appropriate-weight for dates, and ten fullterm small-for-dates (SFD) infants, and their mothers were assessed in the areas of sleep state organisation, maternal perception of her neonate, mother-infant interaction patterns at two, three, and six months, developmental status at four and ten months, and perceived infant temperament at six months. The implications of state variables were focussed on in regard to interaction and developmental status.

Both preterm and SFD infants were comparatively disorganised in their sleep states and in their waking states until three months, with state instability persisting to six months in the SFD group. Sleep state stability predicted ten-month development in fullterm and preterm infants, waking active stage levels at two and three months were predictive in SFD infants. Preterm and SFD infants scored lower than fullterm infants on MDI assessments at four and ten months; maternal stimulation was negatively related to development in the preterm group and positively related in the fullterm group, supporting previous suggestions that preterm infants have a low

threshold for overstimulation. There was a negative relationship in the SFD infants between ten-month development and variables reflecting early infant activity. SFD dyads were remarkably inflexible in their interaction patterns from two to six months, and perceived infant temperament was strongly related to ten-month development.

The findings document striking differences in the course of development in the first year for the three kinds of infants. The importance of considering state related variables is underscored, and the differential effects of stimulation, maternal perception, perceived temperament, and infant neonatal status on the underlying processes of development are demonstrated.

CHAPTER I

INTRODUCTION AND REVIEW OF LITERATURE

The birth of an infant is an event which impinges upon the lives of a family to a degree only properly understood by those who experience it. During the last century childrearing has assumed a position which distinguishes it from the fabric of intergenerational life; "childhood" is a specified time of growth and development set apart from the overall span from birth to death. In the late twentieth century, the advent of a child at the least means an extra demand on resources, and usually brings with it changes in lifestyle.

For the majority of infants the chances of normal development are high. For others prenatal, perinatal and postnatal events lower those chances. Advances in obstetric and neonatal expertise and technology mean that many infants now survive insult in utero, early birth, and postnatal complications when fifty years ago they would have died. The prognosis for many of these survivors is also good but preterm birth, intrauterine growth retardation and neonatal illness constitute risk factors for later development. In some cases damage to an infant is evident at or soon after birth. For the majority of "at risk" infants however, later impairment cannot be predicted with accuracy either by factors surrounding birth or by aspects of the infants themselves. Five per cent of infants are born prematurely, and a further ten per cent are small for their gestational age. Fifteen per cent of the population is thus potentially at risk of later deficit arising from birth factors. At present not only is identification of those most at risk difficult, but the processes taking place between the developing infants and their social and physical environment are poorly identified. Enough is known about the first year of life to realise that in many cases potential deficits can be ameliorated; insufficient is known to understand how best this might happen.

The present investigation was undertaken in an attempt to extend the understanding of early developmental processes for two specific groups of infants known to be vulnerable to intellectual, emotional and social problems. Preterm and small-for-dates infants were compared with a control group of full term normal-weight infants over a variety of measures in the first year of their lives. Sleeping patterns were observed in the neonatal period; mother-infant interactions were studied at three ages; developmental assessments were carried out, and measures of maternal perception and infant temperament taken. A review of the literature relevant to these areas follows, in order to put the study in context.

I. PREMATURITY

The birth of a premature, or preterm, infant is an event which is at the least unsettling for the family involved and is often accompanied by physical, psychological and emotional disruptions. The early birth of an infant is often unexpected so that practical as well as physical and emotional preparation is incomplete; even when there is a clear possibility of premature delivery many mothers ignore the implications preferring instead to consider the alternatives of miscarriage or full-term pregnancy (Kaplan and Mason 1960).

Families, and in particular mothers, then, are seldom prepared for the fact of an early birth and there may be a sense for inadequacy or "unfinished business" for the mother who has failed to carry an infant to term; thus a parent , too, can be considered preterm. Compounding these feelings are the appearance and size of the infant who is not just smaller than a full-term infant but is often visually unattractive by contrast.

In the majority of cases a preterm infant is admitted to a neonatal unit for special care or for observation. This inevitably means that the mother is separated from her infant despite recent changes of practice in many hospitals which allow frequent parent visiting and involvement with the care of the infant. Even when the mother is in the same hospital, in the first days she is dependent upon nursing staff to take her to the neonatal unit. For many women, the experience of being wheeled to visit one's (often ill) infant through a glass screen must add to or encourage feelings of hopelessness and inadequacy. In units where minimal contact is allowed between preterm infants and mothers, maternal self-confidence can be very much lowered (Seashore, Leifer, Barnett and Leiderman 1973).

Many neonatal units now encourage contact between parents and infants in order to minimise the possible effects of early separation. In practice however the situation is still fraught with difficulties for parents. An ill infant is surrounded by technological aids which can certainly intimidate a lay person and can often serve as an effective barrier to parent-infant contact. The welfare of the infant is perforce out of control of the parents who must rely on paediatricians not just for the survival of the infant but for information on progress. Sometimes the fact that the prognosis is unknown combines with poor communication skills in the expert and the need for a definite answer in the parent to produce an unsatisfactory relationship between those in control and those who need reassurance about their infant.

When an infant is not in danger parents are usually involved in feeding and general care, although access to a hospital is often a problem since most neonatal units serve large areas. Disruption to family life, and returning home without the infant, are other difficulties faced by preterm parents. Very few neonatal units have facilities allowing privacy for parents to feed and interact with their infants, so that the spontaneous "baby talk" which might occur is inhibited (particularly for fathers) by the presence of staff and other families (Richards 1982).

Kaplan et al have described four psychological tasks which need to be accomplished by preterm parents. They involve preparation for the loss of the infant; the acknowledgement of the failure to deliver a normal child; resumption of the process of relating to the infant; and an understanding of the special needs of a preterm infant. The extent to which these are successfully accomplished will clearly be affected by some of the aspects of neonatal units discussed above, but parents vary in their responses to preterm birth. Newman (1980) suggests that some cope by commitment; they are determined to "see their baby through", while others cope by distance, finding the tension of visiting a sick infant too difficult and staying away until they are assured of its survival. Fanaroff Kennell and Klaus (1972) noted in a study of low birth weight infants that disorders of mothering were found only in a group of mothers who visited their sick infants less than three times a fortnight, and that patterns of visiting were not related to the timing of contact the mothers had had with their infants. Minde, Marton, Manning and Hines (1980) also found a relationship between visiting patterns and mothering styles; mothers who visited frequently and for long periods were highly active in nursery interactions with their infants and were more responsive to infant signals than infrequently visiting mothers. These findings suggest that "coping by distance" i.e. visiting the neonatal nursery infrequently, has an adverse effect on later mothering. In a recent study Silcock (1984) found that the mothers' ability to cope with Kaplan _et al_'s four psychological tasks predicted mother-infant relationships at one and four months, (although the measures of relationships used were rating scales rather than precise observation). It seems then that encouragement for frequent visiting and support in coming to terms with preterm birth will not only have a present effect of easing a difficult event, but might positively influence later interaction.

In a recent study Zeskind and Iacino (1984) reported on the effects of making regular weekly appointments for mothers to visit their preterm infants in a neonatal unit. Mothers with regular appointments made an increased number of independent visits and gave more positive prognoses of their infants' outcomes; their infants in turn were hospitalised for a shorter time than those in the control group. Trause and Kramer (1983) found in a group of middle class married parents who had large amounts of contact with their low-risk infants in a neonatal unit, that although preterm parents were more upset than full-term parents in the first week after discharge the positions were reversed at one month; full-term mothers were more upset. Trause _et al_ also notes that many of the problem mothers became pregnant again early, suggesting their need to have a full-term, and in that sense, successful, pregnancy. These two studies indicate some improved possibilities for successful adjustment to preterm birth with changed attitudes in neonatal units.

The preterm mother while dealing with the implications of the birth for herself, at the same time is confronted with an infant whose physiological and behavioural organisation is confused. The preterm infant is not just immature; at birth, systems of functioning are precipitated into action which are normally adapted to intrauterine conditions. Thus respiration and vision are activated, while other systems continue to mature at the same rate as in utero. The preterm infant is therefore disorganised in the integration of functions, and progression to term is not the same ex utero as it would be in utero. Als, Lester and Brazelton (1979) offer the following description.

"Not only is the preterm infant an organism in an environment he has not yet evolved for, but he is an organism whose biological program is called upon prematurely so that the normal sequence of subsystem differentiation and integration generally found by term has not yet been executed." (p179).

In considering studies of prematurity it becomes clear that the definition of "prematurity" is based on several different criteria, and is called variously immaturity, prematurity, and low (or very low) birthweight. Comparison of studies is therefore often difficult. Birthweight is most often used in definition particularly in medical studies, despite the criticism as early as 1964 by Drillien who pointed out the confounding of gestational age with birth weight. Following the American Academy of Pediatrics (1964), most studies define infants of low birth weight as those below 2500 grams. Infants of below 1500 grams are considered to be "very low birth weight", and prematurity as less than 37 weeks' gestation. An infant whose weight at birth is not appropriate for gestational age according to defined norms is considered "small for gestational age" or "small for dates", with the implication of intrauterine growth retardation. An infant can therefore be preterm but appropriate for gestational age, preterm and small for gestational age, or fullterm but small for gestational age. Since the effects of prematurity and intrauterine growth retardation may be different, these two factors need to be distinguished in studies of low birth-weight infants; often this is not done.

Many studies, furthermore, give sparse details on the presence or absence of neonatal illness in their samples. Several investigators (considered later) note the effects of illness on mother-infant interaction; most studies however specifically include infants who were ill in their sample, or fail to exclude them.

Another difficulty in evaluating interaction studies especially is the plethora of variables used and the levels at which they are analysed. Strategies range from frame by frame analysis of film and probability matrices of discrete behaviour, to global affective ratings and clinical impressions. Direct comparison of studies is seldom possible.

A fourth issue of concern in considering prematurity is that of socioeconomic status (SES). Poverty undoubtedly places stresses on the low-income mother which middle class families do not face at the same time as dealing with a potentially difficult infant. Prematurity is often associated with poor health and lack of antenatal care, both of which can be characteristics of low SES mothers so that the prevalence of preterm birth is higher for low than middle-income families. These and many other factors such as maternal education permeate considerations of both mother-infant interaction itself and prematurity. SES is sometimes taken into account in the studies to be discussed; however too often it is left to stand on its own merits without allowing for within-class differences in attitudes and behaviour. As Ramey, Farran, and Campbell suggest,

> "for too long research on social and intellectual development has remained at the level of allowing social class as a general term to carry explanatory weight" (p 812).

(1) <u>Newborn Status in Preterm Infants</u>

Several investigators have chronicled differences in performance on the Brazelton Neonatal Behavioral Assessment Scale (NBAS) Brazelton (1973) between preterm infants at term and fullterm infants, finding that preterm infants have poorer motor and autonomic regulation and reflexes (Greene, Fox and Lewis 1983; Field 1977), poorer hand-to-mouth control (Brown and Bakeman 1980; Paludetto, Mansi, Rinaldi, De Luca, Corchia, De Curtis and Andolfi 1982), lower responses to voice and face stimulation (Paludetto *et al*), and lowered interactive processes (Field 1977, Lester, Emory, Hoffman and Eitzman 1976). In all but Field's study, the infants were free of major illness. Hence the preterm mother faces the challenge of learning to relate to a small, physiologically immature, often unattractive infant whose capacity for interaction can be limited at term. Her infant is likely to seem not just physically fragile, but also unable to tolerate or respond to stimulation to the same extent as an infant born at term.

(2) Prematurity and Abuse

In view of the many disadvantages faced by the preterm mother and infant from the beginning, it is not surprising that some studies of child abuse implicate prematurity as one of the contributing factors. Elmer and Gregg (1967) noted that white abused children in their study were often preterm; Goldson, Fitch, Wendell and Knapp (1978) found an association between low birthweight, low Apgar scores, and poor developmental assessments, and child abuse. Lynch (Lynch 1975; Lynch and Roberts 1977) reports high incidences of separation at birth in an abused sample, and the fact that 42% of an abused group of children had been nursed in a special care nursery. Most studies of the aetiology of child abuse are of course retrospective; however Hunter, Kilstrom, Kraybill and Loda (1978) followed 271 families who had had infants in an intensive care nursery for longer than a week, and noted that eight times the overall community incidence of abuse occurred in the sample in the first year. Sixty percent of the abused children though had congenital abnormalities, which limits the validity of their findings for prematurity in general. In two small English follow-up studies Jeffcoate, Humphrey and Lloyd (1979) and Collingwood and Alberman (1979) found abuse, anxiety, and adverse perceptions of their infants in the first year in preterm families (Jeffcoate et al); and rejection, hostility and perceptions of children as destructive, naughty and irritable at five-six years in preterm mothers (Collingwood et al). Yet Boyle, Giffen and Fitzhardinge (1977) reported no abuse and little impact on high S.E.S. families of preterm infants by three-five years.

The role of prematurity in child abuse is clearly complex and is confounded by factors such as S.E.S. In a review Friedrich and Boroskin (1976) conclude that

> "the basic point to be noted is that the premature infant should be considered a "child at risk" within the battered child syndrome."

Since most preterm infants are separated at least briefly at birth from their mothers, separation has been suggested as a potent factor by delaying or preventing bonding (e.g. Lynch et al). Collingwood et al found no differences in separation time between the rejecting and non rejecting mothers; theirs was a small sample, but Douglas and Gear (1976) found no evidence of long-term disturbance in separated low birth-weight infants, in a follow-up of all children born in the first week of March 1946 in England. Field (1977) compared groups of high risk separated, high risk nonseparated and fullterm mothers and infants at three and a half months and found that the risk-group mothers behaved similarly to each other and differently from the fullterm group, suggesting that separation <u>per se</u> was not an influence on mother-infant behaviour.

Perception of an infant as different or worse than average has been cited as a factor in child abuse (Kempe and Helfer 1972). Many factors surrounding the birth of a preterm infant mark it out as different from the beginning, and this perception may be reinforced by lack of infant responsiveness and sensitivity to handling. In the mother whose coping abilities are already stretched by poverty or family stress, these real and/or perceived differences may be sufficient to precipitate abuse.

The association of prematurity and child abuse does not solve many of the problems nor answer many questions surrounding the aetiology of abuse since so many more powerful influences are involved. It does indicate that a stressful mother-infant relationship is likely to be at least a temporary result of preterm birth, and several studies have addressed the question of the nature of the differences between fullterm and preterm mother-infant interactions.

(3) <u>Interaction Studies</u>

Field (Field 1977, Field 1981, Field 1982) has investigated the interactions of preterm infants who had suffered Respiratory Distress Syndrome (RDS) and fullterm infants, with their mothers. She noted that preterm infants at three and a half months used gaze aversion more often than fullterms to terminate contact, and that preterm mothers were more active than their fullterm counterparts in trying to establish and maintain their infants' attention. Preterm infants displayed more sad faces and fewer happy faces than fullterms in play; Field proposes a curvilinear model of interaction where low and high levels of maternal stimulation are related to low levels of infant gaze, and moderate levels elicit higher levels of infant attention. She notes the success of instructions to mothers to imitate their infants in getting their infants' attention, and suggests that gaze aversion in preterm infants is caused by their less developed levels of information processing. Field's observations were made at ages corrected for prematurity (i.e. equivalent conceptional ages), which allowed for possible developmental lags due to immaturity; thus lowered ability to process information would be an effect of prematurity and/or illness. In this regard Rose and her colleagues (Rose, Gottfried and Bridger 1978; Rose, Gottfried and Bridger 1979) found that at twelve months preterm infants (tested at corrected ages) were unable to use crossmodal transfer in visual tasks whereas fullterm infants could; furthermore preterm infants showed lags in their ability to process visual information and to use haptic and visual cues simultaneously. It is likely, then, that at three and a half months gaze aversion would be an effective mechanism for avoiding the overload of stimulation which is more easily handled by fullterm infants.

Crnic and his coworkers (Crnic, Greenberg, Ragozin, Robinson and Basham 1983; Crnic, Ragozin, Greenberg, Robinson and Basham 1983), found similar patterns of maternal stimulation and infant avoidance in groups of preterm and fullterm infants matched for race, maternal education, sex, birth order and family structure. In their sample 46% of the preterm group had suffered Idiopathic Respiratory Distress Syndrome. Using global ratings and questionnaires however, these workers detected no differences between groups in laboratory observations at four months which suggests that more molecular measures are needed as well, at least in the early months, in order to discriminate dyads.

The findings of Crawford (1982) are based on repeated home observations at uncorrected ages for 17 preterm infants and matched controls at six, eight, ten and fourteen months, with several of the preterm group having suffered RDS and apnoeic episodes. In the early observations preterm infants fretted and looked at objects more and played less than fullterm infants; they vocalised less at all times. Their mothers showed higher levels of affectionate behaviour; however although preterm mothers spent more time in interaction than mothers of fullterm infants, they spent less time overall with their infants - an indication, the author suggests, of the preterm mother's feelings of lack of involvement with her infant.

In the studies mentioned so far all preterm infants had suffered from illness in the neonatal period. Brown and Bakeman (1980) followed a sample of black, low-SES fullterm and preterm dyads in which the preterms had spent no longer than 24 hours in the intensive care nursery. Observations were made at uncorrected ages of feeding interactions in the hospital and at one and three months post discharge. They found that at all stages preterm mothers were more active than fullterm mothers, while their infants were less active, and were less likely to act alone. Brown et al used a behaviour dialogue level of analysis which considered probabilities of mothers and infants acting alone or together, and which distinguished preterm and fullterm dyads more successfully than measures of behaviour frequency.

Barnard, Bee and Hammond (1984) also considered healthy preterm infants, in a study of 88 preterm dyads and a fullterm sample which was not strictly matched since it came from a separate study. All dyads underwent the same observations of feeding and teaching interactions at four, eight and 24 months. Barnard et al found that preterm infants were less involved in feeding situations, but at eight and 24 months more involved than preterm infants in teaching interactions although fullterm mothers used more positive and negative messages, more teaching techniques and higher levels of facilitation. In view of Crawford's report that preterm infants looked at objects and places more than fullterm infants, this suggests that preterm infants at this age are visually oriented toward their physical environment. It is likely, too, that a mother's involvement with a teaching task means that she is less concerned with direct stimulation of her infant which might continue to be aversive at this age, and more concerned with mediating between infant and objects. The finding that fullterm mothers in the Barnard et al study used higher levels of facilitation accords with a report by Stern and Hildebrandt (Note 1) that mothers who were interacting with another mother's infant which was labelled preterm chose toys for play which were rated as appropriate for younger infants. Stern et al suggest that this indicates a prematurity stereotype; mothers of preterm infants though may simply be responding to the developmental level of the infant.

As mentioned earlier several studies have distinguished between preterm sick and preterm healthy infants in an attempt to understand the relationships between infant illness and mother-infant interaction. Greene, Fox and Lewis (1983) matched groups of healthy preterm, sick (RDS) preterm, healthy fullterm, and sick (birth asphyxia) fullterm infants on sex and socioeconomic strata. They found few differences in infant behaviour at three months, but mothers of preterm infants were more responsive than fullterm mothers. Sick infants had scored lower than healthy infants on orientation measures in the BNAS at term, and orientation accounted for some variance in infant and maternal behaviour at three months; hence neonatal illness appeared to have an effect on subsequent behaviour, albeit complex; and this study failed to clarify the precise contributions of illness and prematurity. Clearer findings of the effects of sickness are reported by Brachfield, Goldberg, and Sloman (1980) who compared groups of healthy preterm, sick preterm, and fullterm infants. They found that in floor play observations at eight months sick preterm infants were less responsive and more irritable than healthy preterms; further, their mothers were more active in engaging and stimulating their infants. The findings are limited by the fact that the sick preterms were younger than the healthy preterm infants; however a comparison of sick preterms with age-matched controls (Goldberg, Brachfield and Di Vitto 1980) showed that immaturity was not the main cause of differences. These investigators also noted that both preterm groups became more irritable after leaving hospital, whereas fullterm infants became less irritable and more alert. They reported furthermore, in general agreement with Greene et al, that differences between groups in feeding interactions had largely disappeared by four months and those which remained were predominantly maternal measures.

This finding of the effect of neonatal illness in the behaviour of preterm mothers is supported in a careful study by Minde, Whitelaw, Brown and Fitzhardinge (1983). Groups of "well" and "sick" preterm infants (defined by a morbidity scale which assessed duration and severity of illness) were matched for sex, SES, and gestational age, and observed in feeding interactions with their mothers three times in hospital and once two months post term. Clear effects of infant illness were apparent in the mothers' behaviour. In hospital mothers of sick infants touched, smiled, and looked _en face_ at their infants less than mothers of well infants. At two months post term mothers in the sick group continued to touch their infants and smile less, despite no observed differences in infant behaviour. In a previous study Minde, Marton, Manning and Hines (1980) had noted a relationship between psychological factors in the mothers' backgrounds and their level of activity with their infants; in a subgroup of long-term-illness infants in the 1983 study, mothers displayed low levels of interaction regardless of their psychological backgrounds. Although differences in maternal behaviour at two months may attenuate, this study is strong evidence of the effect on mothers of serious neonatal illness. Differences between the neonatal behaviour of sick and well preterm infants have been demonstrated in some of these studies (Greene _et al_ and Minde _et al_); a report by Holmes, Nagy, Slaymaker, Sosnowski, Prinz, and Pasternak (1982) indicated that sick infants (both preterm and fullterm) performed poorly on interactive and motoric processes on the NBAS 48 hours after discharge. It is unlikely that differences in later infant behaviour disappear completely, and the Brachfield _et al_ study confirms this; nonetheless the apparently strong effect of neonatal behaviour and illness on later maternal behaviour demonstrates the transactional nature of early development (Samaroff and Chandler 1975). The mediation of maternal response between early infant behaviour and health status and later interaction makes prediction from early to later infant behaviour difficult. These studies demonstrate, too, that there may be differential responses by mothers to variations in infant condition. In turn infant reaction to maternal behaviour styles may depend on factors within the infant which are determined by illness or prematurity or growth retardation. The questions of the complex relationships among these factors are only now beginning to be addressed, and careful studies are needed like that of Minde et al in order to clarify the paths of influence.

(4) Interaction and Outcome

Despite the realisation that differences almost certainly exist between the developing interactions of preterm and fullterm dyads, few studies have yet considered the relationships between interaction and outcome though the assumption that they exist implicitly underlies the research discussed so far.

Numerous investigators have chronicled the later intellectual performance of preterm and low birthweight infants, and these reports will be reviewed in the next section. Intellectual performance is comparatively easy to measure; there is an abundance of instruments available and testing is often a part of progress through the education system so that assessment of cognitive functioning is the most common outcome to be considered. However performance on an IQ test is neither the only nor the most important measure of functioning; social competence is also salient for satisfying living and it probably determines, at least to some extent, intellectual performance e.g. Lamb, Garn and Keating (1981).

The interrelationship of social and cognitive competence is complicated and will not be pursued here, but early mother-infant relationships are salient for both, and many studies will be required to determine which factors in infancy relate to each or both area(s) of competence. An attempt to elucidate some of the patterns is that of the Los Angeles study (Beckwith, Cohen, Kopp, Parmelee and Marcy 1976; Beckwith and Cohen 1984; Sigman, Cohen and Forsythe 1981; Sigman, Cohen, Beckwith and Parmelee 1981). Over 100 preterm infants from all socioeconomic strata were observed in interactions (at equivalent conceptional ages) at one, three, eight, 21 and 24 months. Gesell Developmental Schedules were administered at four nine and 24 months, and at five years performance on the Stanford Binet was assessed. The major finding from this study was that several measures of caregiver-child interaction at 21 and 24 months predicted performance on the five-year Stanford-Binet tests; furthermore, consistency of responsive caregiving over the first two years was important for five-year development. Perinatal complications were not related to cognitive outcome (as measured by the Stanford-Binet test), but presumably affected the caregiving environment which was most potently associated with test performance. Infant measures which were independently related to outcome were irritability and non-distress vocalisation.

A major aspect of the Los Angeles study was the impact of SES on caregiving style and cognitive outcome; the latter will be discussed in a subsequent section. The investigators found that high SES parents talked more at one month; had higher levels of total talk, face-to-face talk, and contingent vocalisation at eight months; spent more time in intellectual tasks and had more overall interaction with their infants at 24 months. Importantly, high SES parents were able to maintain consistently high levels of responsivity more easily than low SES parents although the findings for interaction and consistency with regard to five-year performance are independent of social class. As the authors point out socioeconomic status ratings do not explain variations within a social class in terms of caregiver style. Overall the findings support the authors' assumption that social environmental factors can ameliorate or exacerbate perinatal difficulties. However Stanford-Binet assessments do not detect more subtle functional deficits, and the finding that the group of preterm infants performed within normal range, while in agreement with several other investigators (see following section) does not explore the question of levels of school failure, for example.

Bakeman and Brown (1980) assessed the social competence and social participation of their sample of healthy preterm and fullterm low SES children at three years old as well as administering the Stanford Binet. Social abilities were assessed at a day-camp where staff interacted with the children and each child was videotaped at play. Social competence was defined as "the ability to navigate the social world smoothly, gaining both material and emotional 'goods' from others in socially accepted ways" (p 441), and was assessed by consensus by the participating adults. Social participation measured the child's involvement with others, assessed from the video tapes. The sample had been observed in feeding interactions in hospital and one and three months post discharge, and assessed with the Bayley Mental Development Index (MDI) at 12 and 24 months. The investigators found that cognitive development at 12, 24 and 36 months was not predicted by any early interactive variables; it was, though, by birth status (preterm vs fullterm). Maternal verbal responsiveness measured on the HOME scale at nine and 20 months was, however, related to three-year Stanford Binet scores. Infant responsiveness at three months (rated by an observer) and the two measures of maternal responsiveness at nine and 20 months were correlated with social competence at three years.

Comparison of these two studies indicates the problems inherent in choices of variables and levels of analysis, and in situations chosen for observation. Bakeman _et al_ observed only feeding situations, and analysed their frequency data as dialogic measures. Beckwith _et al_ observed infant interactions over all activities while the infant was awake, in both naturalistic home settings and standardised laboratory situations. Variables were chosen for analysis at each age which the authors considered characterised responsive caregiving. The major point of comparison for the two groups is in the relationship of birth status and perinatal complications to interaction and later outcome. Bakeman _et al_ found that neonatal status (preterm versus full -term) predicted later cognitive outcome although early interactive measures did not, yet the same interactive measures had discriminated preterm and fullterm dyads. Within the rubric of prematurity, Beckwith _et al_ found that perinatal complications were mediated by caretaking variables. It may be that prematurity _per se_ constitutes biological insult which is comparatively impervious to environmental mediation and authors of several outcome studies suggest that neurological impairment might be an important factor in the intellectual performance of some low birth weight infants (Caputo and Mandell 1970). Alternatively more extensive measures over a greater temporal and situational range might have detected relationships between interaction and outcome in the Bakeman _et al_ study.

Questions concerning the inter-relationships of prematurity, illness, parent-infant interaction and outcome therefore remain. In the next section the large body of studies concerned with developmental outcome and perinatal factors will be considered.

(5) Studies of Developmental Outcome

Interest in the developmental sequelae of premature birth has been keen for over 60 years, and despite problems with definition of prematurity several large studies have been conducted. In the 1950s the Baltimore Study and Edinburgh Study, and in the 1946 the National Maternity Survey was initiated, and results of these will be considered first. In all of these "prematurity" is defined by birthweight rather than gestational age, so the word "preterm" is inappropriate for this section. "Premature" will be used to indicate the low birthweight groups.

Douglas (1956) assessed 676 premature children (less than five and one half pounds) and carefully matched controls at eight years with a series of standardized tests, and found that the premature children performed significantly less well on overall IQ, vocabulary, and especially reading. At eleven years (Douglas 1960) the discrepancy was even larger, with the prematures having lower scores on reading, vocabulary, mental ability and arithmetic. At this age the social and educational backgrounds of parents were noted to be related to intellectual performance; in particular the care and interest of the mothers of the children was important.

The Edinburgh Study (Drillien 1964) followed nearly 600 children, classified into four birthweight groups two of which (those below five and one half pounds) were designated premature. Regular developmental assessments from six months to four years were carried out. It was found that scores fell with decreasing birthweight, and SES was significantly related to development. Intelligence tests at school showed the same pattern, with premature children working below capacity more often than controls. Although obstetric factors were not related to development, they were predictive of disturbed behaviour at school (as was SES).

The third investigation, the Baltimore Study, followed over 800 children until 12 - 13 years carefully matching premature (low birthweight) infants and controls on social class, race, parity, and season of birth (Wiener, Rider, Oppel, Fischer and Harper 1965; Weiner, Rider, Oppel and Harper 1968). At 40 weeks, three-five years, six-seven years, eight-ten and twelve-thirteen years low birthweight infants were discriminated from control infants by a variety of assessments. In contrast to the Edinburgh and National Survey studies though, SES was not a significant factor in outcome, and the authors noted that the larger group of low birthweight infants (1500-2500 grams) suffered little or no impairment.

They suggested too that lowered mental performance was largely due to neurological defect associated with low birthweight.

These early studies are valuable for their size, and the consensus of findings that prematurity (based on birthweight) is a significant risk factor for developmental delay. (These and other studies also found an increased incidence of significant handicap and subnormality in premature groups. Since this issue is not of direct relevance to the present investigation, it will not be pursued). The effects of SES are clear in the two British studies, yet apparently negligible in the Baltimore investigation. It is tempting to speculate that a history of class differences in Britain has led to entrenched differences in attitudes to child rearing and opportunities for children to benefit from educational facilities, whereas social mobility in the United States minimized such differences.

Another British study initiated a decade later, is that by Francis-Williams and Davies (1974). Very low birthweight infants (less than 1500 grams) were administered intelligence tests between four and twelve years of age. Controls were not used on the evidence from other research that very low birthweight infants will perform at a lower level than full-weight infants, but the sample was separated into small-for-dates and appropriate-for-dates groups, and further divided into years of birth (1961-64, 1965-68) in order to assess the effects of changed neonatal care. The authors found no relationships between birthweight, gestational age or neonatal illness and IQ scores but a significant correlation between social class and full-scale IQ scores. The Bender Gestalt test was administered to 65 children over five years old; 55.4% of these scored one or two standard deviations below the normal performance for their age and ability indicating, the authors' suggest, difficulty with integration which is a central process of reading. Although no differences in full-scale IQ were noted for the two birth periods, the children born in the later years appeared to the authors to be making better progress in reading; the only differences in care listed by the authors between the two periods were increased food intake in the first week and higher body temperature in the first month of life.

This study notes the improved outcome for low birthweight infants a decade after the earlier studies, but the relevance of its findings is limited to very small infants. Neligan, Kolvin, Scott and Garside (1976) designed a followup study of children born in Newcastle in 1961 - 62, which attempted to clarify the differential effects of intrauterine growth retardation and preterm birth. The findings relevant to the former are discussed in the appropriate section; of interest to this discussion is the definition of prematurity in terms of gestational age (less than 255 days) rather than birthweight. One of the major strengths of the Neligan et al study is the large population base within which it was carried out in Newcastle, allowing generalisation of findings beyond specific hospitals and subgroups. Statistical analyses were thorough, and samples chosen were not at extremes of weight or gestational age but represented a large group (15%) of infants born in Britain.

Over a range of measures of performance at five, six and seven years the preterm (short gestation) group performed adversely compared with the control group. The effects of social class were apparent on psychological, behavioural and neurological assessments (the last contradicting the assumption that neurological defecit is immune to environmental influence), but impaired performance persisted when effects of several biological, clinical and environmental factors were partialled out. The effects of these associated factors were differential for preterm and SFD children; for the preterm group biological and clinical factors were the most potent.

Although no interaction measures were included in this extensive study, the authors acknowledged the need for specificity within the definition of social class and assessed the quality of the mother's "care of the child." This was simply a rating done by health visitors when the child was three years old, and included various dimensions such as cleanliness and affectionate interest, all of which were subsumed under the single assessment of "good", "average", or "poor". Despite the limitations of such a global measure, it proved to be the most important environment factor in outcome. It clearly subsumed critical factors within socioeconomic distinctions, and suggests the need for investigation into the relationships among caretaking and outcome measures. The National Survey (Douglas 1960) also noted the effect of maternal care and interest on outcome.

A study of preterm and SFD infants born at about the same time as those in the Neligan study is one by Rubin, Rosenblatt, and Balow (1973) in the United States. Two hundred and forty one subjects underwent detailed assessments to age seven years. Results confirmed Neligan et al's conclusion that SFD children were more at risk by school age than low birth-weight preterm children; low birth-weight males also had high incidences of school-identified educational problems. Contrary to Neligan's findings, however, was the lack of relationship between SES and outcome in this North American sample.

Many of the outcome studies with children born in the 1970's are from North America where cultural differences in childrearing patterns, social stratification and attitudes to prematurity are likely to affect the findings in comparison with British studies. Results on the effects of prematurity are varied in these studies. Beckwith et al reported that their group of preterm children performed within normal range on cognitive tests at five years; however the findings are limited by lack of a control group. Crnic, Ragozin et al found that their group of preterm infants performed adversely on the Bayley MDI compared with controls at four and twelve months. The preterm group though was defined as less than 1801 grams and 38 weeks' gestation, so that prematurity was confounded with the effects of intra-uterine growth retardation and very low birth-weight. Bakeman et al compared healthy, low SES preterm and fullterm infants (defined by gestational age and birth-weight) at corrected ages, and found group differences in cognitive performance at three years but not twelve months. Ungerer and Sigman (1983) compared preterm and fullterm infants at corrected and postnatal ages during the first three years in order to assess the importance of biological maturity. Delays in language ability at 22 months, and visual information-processing tasks at three years were found despite correction for lags in maturity. Zarin-Ackerman, Lewis and Driscoll (1977) noted language deficits in sick preterm infants at two years; Ungerer et al included a score of postnatal complications in their study (which was significantly higher for the preterm group), but this was not specifically related to language ability at 22 months. The findings of Rose et al on the reduced ability of preterm infants to process visual cues supports the Unger et al findings here at 36 months. Impaired performance by preterm children on the Bender-Gestalt test (Francis-Williams et al) might be further evidence of a visually related specific deficit in many preterm children. Caputo, Goldstein and Taub (1979) also found that at seven to nine years a group of middle-class preterm children performed less well than fullterm controls on the Bender-Gestalt. Their scores on performance but not verbal IQ testing were also low.

The apparently conflicting findings of some of these studies are explained at least in part in an elegant study by Grigoroiu-Serbanescu (1981, 1984). Over 300 preterm infants were classified by gestational age and birthweight into three groups of increasing prematurity, and compared with a matched fullterm normal birthweight control group. Annual assessments of cognitive performance and emotional maturity showed that after three years and until six years of age the preterm groups performed as well emotionally and intellectually as the fullterm children. However at six and seven years boys below 2000 grams and 34 weeks g.a. performed poorly compared with the fullterm group on cognitive tests; at seven years boys and girls born below 2000 grams and before 34 weeks g.a. were less mature emotionally than their fullterm counterparts. Problems in school adjustment were found for boys and girls below 1500 grams and 29 weeks g.a. and for boys below 2000 grams and 34 weeks g.a. This pattern of development for small preterm infants, described by the author as "oscillating evolution" concurs generally with the findings of Neligan et al who noted adverse performance for preterm infants at six to seven years; with those of Rubin et al who found increased levels of school problems in low birthweight infants; with Beckwith et al who found performance within normal range at five years, and Crnic et al who noted differences in performance at four and twelve months. Apart from emphasising the non-linear aspect of development in preterm infants (a point noted in regard to interaction in observations by Brachfield et al), the Grigoroiu-Serbanescu data underlines the contributions of gender and extent of prematurity to subsequent performance.

A recent report by Silva, McGee and Williams (1984) suggests however that preterm infants might not be so much at risk for developmental delay as they used to be. Repeated intelligence testing at three, five, seven, and nine years of age of a subgroup of preterm children within a large sample indicated that preterm children performed as well as the fullterm population. However testing was with the Stanford-Binet and Weschler Intelligence Scales (the latter with comprehension and picture arrangement omitted), so that subtle visual or language deficits might have been overlooked. Furthermore, the preterm group is not subdivided with regard to birthweight or gestational age. Nevertheless, the comparison in this study of the adverse performance of SFD children with the normal performance of the preterm group points to the improved outlook for preterm infants.

In summary, the event of preterm birth is inherently fraught, and a successful outcome for parents and children is influenced by many factors. At the time of birth, families have psychological tasks to confront; the extent and manner in which they cope with these may have effects on later parenting patterns. In the neonatal period preterm infants typically are unresponsive interaction partners. The difficulties which this presents together with separation of mothers and infants and infant illness in the early weeks may lead to partial or complete failure in the bonding of parents to infants, which is presumed to contribute to the aetiology of child abuse.

Studies of mother-infant interaction generally concur in finding a pattern in the preterm dyad of unresponsive infant and active, often overstimulating mother. Several investigators have implicated infant illness as well as prematurity _per se_ in the altered behaviour of preterm mothers.

Few studies have addressed the relationships between patterns of mother-infant interaction and outcome for preterm children. Those which have find links between levels of responsiveness in both infants and mothers, and later measures of cognitive and social competence. However findings are sparse and there is a need for more research into this area in view of the possibility of education for mothers of preterm infants.

Several large followup studies of premature infants have found strong effects of socioeconomic status on later intellectual functioning and behaviour. Within social-class factors, though, are other environmental considerations such as maternal care, affection, and level of education which also influence outcome. It seems probable that prematurity, regardless of SES factors, exerts an independent influence on later functioning though differences between fullterm and preterm infants appear to be subject to developmental oscillations, particularly in low g.a. low birthweight infants. Many studies report no group differences on global IQ ratings, but deficits emerge in areas such as language development and visual information processing. The contribution of perinatal illness to later functioning is equivocal.

Most preterm infants, especially those of higher birthweights, reach adulthood with normal intellectual functioning. However the consensus of findings that as a group they are more at risk of disabilities ranging from severe retardation to minimal dysfunction than fullterm infants suggests that more information is needed on what affects the development of these children. The discovery that even neurological functioning (Neligan _et al_) is susceptible to environmental influences indicates that mediation can, in principle, be effective.

II SMALL FOR DATES INFANTS

The group of infants designated "small-for-dates" or "small for gestational age" is identified as those infants whose weight is inappropriately low for the length of gestation. Definition of a small-for-dates (SFD) infant varies; in most instances birthweight is used as the criterion, against scales for the normal distribution of weight for age. Upper limits of weight-for-age for inclusion in a SFD group range from the 25th to the third percentile; other measures used include two standard deviations below the mean as an upper limit.

Although birthweight criteria are most often used in delineating groups of SFD infants, the underlying assumption that low birthweight is indicative of foetal malnutrition in utero is not always justified (Wilcox 1983). An infant who through constitutional and maternal factors is destined to be large and who suffers intra-uterine malnutrition, may have a weight within normal limits at birth. Conversely a small infant may be appropriately grown given genetic and other factors. An attempt to overcome this possible confounding of normal with malnourished infants has been made by use of the Ponderal Index (P.I.) which is a ratio of the percentage of bodyweight to the cube of the body's length (Miller and Hassanein 1971). Most studies, however, still use birthweight as the basis of definition, often with correction for maternal height and infant sex.

Identification of SFD infants at birth is thus subject to some variation; even more variable is the aetiology of these neonates. The unifying factor of their condition is that foetal growth has been impaired; however the relationships between the timing and causes, and the subsequent development of the infants are complex and not completely elucidated. Of particular concern is the effect of foetal malnutrition on brain growth. Dobbing (1981) points out that in humans a brain growth spurt occurs from midpregnancy to approximately eighteen months postnatal age. The timing of the onset of growth retardation will to some extent determine which aspects of brain functioning will be affected; Harvey, Prince, Bunton, Parkinson, and Campbell (1982) monitored growth by serial altrasonic cephalometry and found that children in whom head growth began to slow before 26 weeks' gestation performed significantly less well at five years of age than children whose growth was affected later in gestation. In most studies however, it is difficult to determine the point at which growth retardation started.

The aetiology is also complex. Known causes are genetic conditions, congenital infections, maternal conditions, maternal ingestions, and placental abnormalities. In a major review article Allen (1984) summarises the known prevalence of these causes of neonatal growth retardation, but notes that up to 50%

of SFD neonates have no identified casual factors.

The SFD category thus presents a heterogeneity of aetiology and identification. A range of follow-up studies suggest however that no matter how they are identified, they are a group at risk of later problems ranging from severe mental and physical disability to mild behaviour and learning problems, though (like preterm infants) the majority experience normal development.

Many issues in follow-up studies are unavoidably confounded; obvious examples are unknown aetiology and timing of onset of growth retardation. Several studies consider infants who are both SFD and premature, and these will be discussed apart from those which separate the factors of prematurity and growth retardation since both kinds of studies look at different aspects of growth retardation.

(1) <u>Preterm-SFD Studies</u>

Most studies in this group were concerned with groups of very-low birthweight (VLBW) infants, who were divided into preterm appropriate for dates (AFD) and preterm SFD subgroups. Francis-Williams and Davies (1974) tested over 100 VLBW children between four and twelve years of age using the Weschler scales, and found that SFD children's mean full-scale and performance IQ was lower than the AFD infants. The SFD children also had higher levels of school failure despite normal IQ performance. Ounsted, Moar and Scott

(1983) also noted lower mean developmental scores at four years for SFD than AFD children, and Low, Galbraith , Muir, Killen, Karchmar, and Campbell (1978) found that SFD infants scored lower than AFD infants on the Bayley MDI at twelve months.

However later follow-up of this sample (Low, Galbraith, Muir, Killen, Pater and Karchmar (1982) found no significant differences between SFD and AFD groups on developmental and language measures by six years. Eaves, Nuttall, Klonoff, and Dunn (1970) reported that although SFD preterm infants scored more highly than AFD preterms in the first year on Griffiths scales, after 18 months the SFD group scored lower than the AFD group, Vohr and Oh, (1983), however, found that SFD preterm infants scored lower than their AFD counterparts until three years, but from three to five years there were no group differences in scores on the Stanford-Binet. Drillien (1970) found that preterm SFD infants had higher frequencies of borderline intelligence than other birthweight groups at ten - twelve years, and Commey and Fitzhardinge (1979) reported 42% of preterm SFD infants as having subnormal intelligence at two years.

When compared with other preterm infants, therefore, it is clear that SFD infants are more likely to have lowered intellectual performance. The findings of the Vohr and Oh study are an exception, though as the authors point out the sample size was comparatively small.

(2) Fullterm SFD Studies

Several studies have noted behavioural differences between term SFD and normal-weight infants at birth. Michaelis, Schulte and Nolte (1970) compared 22 SFD infants with 25 AFD infants and found that the SFD group had poor Moro reflexes, standing response and stepping movements, and poor or absent head-lifting responses. Frederickson and Brown (1980) also noted poorer Moro reflexes and more sustained grasping reflexes in SFD infants. Als, Tronick, Adamson and Brazelton (1976) examined ten apparently healthy SFD infants using the Brazelton Neonatal Behavioural Assessment Scale (BNBAS) and reported that the SFD group showed aberrant reflex behaviour until ten days old, were comparatively unattractive physically and not able to make use of stimulation. They performed poorly on the interactive dimension and motor processes, did not cry easily but were difficult to console when they did. Als et al suggest that the SFD infant "wants to be left alone", and "does not interact in a focused and modulated manner with the animate or inanimate environment" (p 599). Lester and Zeskind (1979) noted similar findings; SFD infants who had had normal deliveries and were healthy showed poorer interactive and motor processes, state and physiological organisation than full-weight infants. Lester and Zeskind also reported that SFD infants differed from the normal-weight infants in their cry patterns. Their initial cries were short, and their cries had higher fundamental frequencies and fewer harmonics than normal-weight infants. Furthermore, fundamental frequency was correlated with the four Brazelton Scale dimensions, which the authors suggest indicates that cry features may be sensitive to the risk status of the neonate.

There is thus considerable evidence to indicate that SFD infants at birth show signs of neurological and interactive disadvantage. The Brazelton Scales have been found to have moderately good predictive validity for later functioning (Hubert, Wachs, Peters, Martin and Gandour 1982); the newborn behaviour of the SFD infant would therefore seem to put it at risk of interactive and developmental problems.

Follow-up studies to determine intellectual performance of SFD infants vary in their findings. Zeskind and Ramey (1978, 1981) found that in a group of SFD and AFD black low SES infants, SFD infants scored lower than AFD infants on the Bayley MDI, and Stanford-Binet at three, 18, and 36 months. Silva, McGee and Williams (1984), in a large follow-up study of preterm, fullterm, and SFD infants, found that the SFD group scored consistently lower than the other groups at three, five, seven and nine years, despite no differences in SES levels or maternal IQ. Neligan <u>et al</u>, (1976) in their comprehensive study of children who were SFD or preterm at birth, at five to seven years found that both groups were

> "associated with impaired performance over a wide range of cognitive and sensorimotor functions at the age of five to seven years, but the adverse effects of being too small are more severe in degree (though similar in kind) than the effects of being born too soon" (p 37).

Harvey et al, as noted earlier, found that infants whose onset of growth retardation was before 26 weeks' gestation scored lower on McCarthy scales at five years than both the control infants and those whose head growth slowed after 26 weeks.

However Parmelee and Schulte (1970) found no differences in performance on 40 week Gessell examination between SFD and AFD fullterm infants; Westwood, Kramer, Munz, Lovett and Watters (1983) found tendencies toward lower scores for SFD children on verbal and fullscale WISC assessments at 13 - 19 years, but noted that performance of the SFD children was within normal range. Fitzhardinge and Stevens (1972), and Babson and Kangas (1969) also reported that SFD children performed within normal range on IQ tests.

Nevertheless several investigators have found that SFD children have high incidences of behaviour problems and school failure despite normal performance on IQ tests. Fitzhardinge et al noted that 50% of SFD boys and 30% of SFD girls experienced failure at school. Silva et al reported that as well as lower intelligence scores at five, seven, and nine years than preterm children, the SFD group had higher levels of parent - and teacher - reported behaviour problems at those ages than preterm and control group children. Neligan _et al_ found that the group designated "very light for dates" (below the fifth percentile on birthweight) had high levels of behaviour problems on mothers and psychologists' reports, and were found to be more hyperactive and fidgety at seven years than other children in the study. SFD children in the Minneapolis study by Rubin _et al_ had lower levels of intellectual performance at school than full-weight fullterm subjects, and were more likely than the preterm and fullterm groups to experience school problems and special placement, with more than half of the SFD group receiving special services. McGee, Silva and Williams (1984) looked at perinatal, socio-economic, and developmental aspects of a group of children characterised at seven years as having stable behaviour problems and found that the only perinatal factor associated with the group in comparison with the rest of the sample was being SFD.

Walther and Ramaekers (1982a) studied 25 fullterm infants below the tenth percentile in weight and showing evidence of subacute foetal distress (low Ponderal index and evidence of wasting), matched for sex, birth order and SES with a normal-weight control group. They assessed the language development at three years of age and found that the SFD group were delayed in verbal comprehension and expressive language in relation to control children; they noted a firm connection between language delay and behaviour problems; in an assessment of behaviour problems and neurological functioning at the same age, (judged by a Behaviour Screening Questionnaire and clinical observations) 32% of the SFD group and 8% of the control group were identified as having moderate to severe behaviour problems. 36% of the SFD and 4% of the control children were classified as showing neurological dysfunction (Walther and Ramakers (1982b). Fitzhardinge et al found in their sample that 29% of the SFD group had speech problems at three and four years (compared with 6% in the control group).

It seems then that although SFD children often perform adequately on IQ assessments, they are likely to experience behaviour problems, language delay, and school failure. Suboptimal reflexes and interactive capacities at birth are likely to contribute to infant-environment interaction difficulties which in turn may not be overcome sufficiently to prevent developmental disadvantages. Language delay and subtle neurological difficulties (Walther et al), poor reflexes (Michaelis et al, Als et al), differences in cry frequencies (Lester et al), and behaviour problems (Silva et al, Walther et al), all suggest a biological mediating factor which would be predicted by the nature of the group by definition. The evidence indicates that developmental problems for SFD infants are specific rather than global, and are presumably influenced by the timing and severity of foetal malnutrition.

Dobbing (1981) points out however that the environmental factors of stimulation or deficit cannot be ignored, and several studies note the mediating influence of socioeconomic status. Drillien found differences between AFD and SFD preterm children's IQ scores in lower but not middle class families at ten - twelve years. Eaves *et al* also noted the effects of social class by two years of age in their study of low birthweight SFD and AFD children. Vohr *et al* found a positive correlation between socioeconomic status and development at five years but not one year. Neligan *et al* found that differences among SFD, preterm, and control groups persisted despite controlling social-class variables. Of considerable interest, however, is their discovery that a grouping of factors associated with outcome designated "family factors" and comprising father's occupational class, mother's care of child, mother's expectations, and psychological scores in the mother, were more strongly related to outcome than clinical and biological factors. Commey *et al* found no relationship between socioeconomic status and outcome at two years, and Silva *et al* reported no differences in socioeconomic status among SFD, preterm, and control groups who scored differentially at five, seven and nine years.

The only attempt to study directly the effects of environmental factors on early development of SFD children has been made by Zeskind and Ramey (1978, 1981). Infants from low socioeconomic status black families had been randomly assigned to day care (experimental) and home (control) groups; both groups contained five low Ponderal Index (SFD) infants. At three months SFD infants had lower MDI scores than AFD infants in both groups; but by 18 months SFD infants in the experimental group scored as well as AFD infants, and SFD infants in the control group scored lower than AFD control infants and SFD experimental infants. This pattern was replicated at 24 months on Stanford-Binet scores. Furthermore, maternal involvement with the infants was the same for all four subgroups at three months but by 18 months was lower for the SFD control group than the other subgroups.

Although the number of SFD infants in this study was low, it does provide evidence that, at least at the extreme of socioeconomic status, environment support can be instrumental in helping development in SFD infants. No studies to date have looked at the precise interactions of SFD infants and their parents in the first year, although studies of preterm mother-infant interactions are considerable in number. There is sufficient evidence of increased risk of adverse outcome for SFD infants to justify such studies in order to describe mechanisms of interaction, particularly as relationships between interaction patterns and development have been demonstrated for preterm infants. Furthermore the apparent subtlety and specificity of deficits in SFD infants together with the suggested biological involvement, make identification of early detection factors not only important, but probably different in kind from those for preterm infants.

Overall, despite variations in aetiology and definition studies of SFD infants show that, whether preterm or fullterm, their outcome is often less optimal than the appropriately-grown infant. Several investigators have chronicled specific deficits such as language delay, behaviour problems associated with neurological deficit, hyperactivity and school failure, often despite normal performance on global cognitive assessments. The biological insult underlying these problems is nonetheless susceptible, in many cases, to environmental modification; investigation of the mechanisms operating between specific aspects of the social and physical environment and SFD infants has not yet taken place.

III THE CONCEPT OF STATE.

The term state is used, particularly in infant research, to describe clusters of behaviour which define the condition or status of the infant at a particular time. "State" is a psychological construct, and is typically defined operationally rather than conceptually since there is disagreement, as with many other constructs, over its theoretical definition. One view sees state as describing a continuum of arousal from deep sleep to high waking activity (e.g. Prechtl 1965). However Korner (1972) points out that E.E.G. measurements show that arousal levels in active sleep are as high as those in some waking conditions; furthermore, the delineation of numbers and positions of points on any continuum poses a problem for operational definition (Lewis 1972, Ashton 1973).

Despite problems of conceptual definition, state occupies an important position in infant research, and its ubiquitous use arises mainly from two sources. One is the prevalence of infant sleep studies in which sleep states are defined using E.E.G., rapid-eye movement (REM), and respiratory measures (e.g. Roffwarg, Muzio, and Dement 1966, Drefus-Brisac 1970). Behaviour state criteria are found to correlate with physiological measures of sleep states (e.g. Korner 1972), which gives encouragement to the use of behaviour criteria for identification of waking states.

The second impetus for the continuing study of state, both as a variable in its own right and as a mediator others, is the realisation that investigations of infant responses to stimuli have varying results when state is controlled for. Both response levels and kinds of responses differ according to state (e.g. Korner 1969); furthermore the growth of interaction studies has brought about the realisation that infant state has a potent effect on the behaviour of caregivers. Sleep and waking state studies will be considered separately.

(1) Sleep State Studies

The first extensive study of infant sleep state patterns was done by Roffwarg et al, who were interested in the role of rapid-eye movement (REM) sleep in infancy. They noted the apparent need for REM sleep in adults, (as shown by deprivation studies in which the amount of REM sleep increased after subjects had been deprived), and the association of REM sleep with dreaming. Roffwarg and his colleagues found that infants spent almost 50% of their time in REM sleep (a finding supported by Thoman, 1975), and that there is an 80% diminuition of REM sleep from the neonatal period to young adulthood whereas non-REM (NREM) sleep diminishes only 25% over the same period.

The periodicity of the sleep state cycle is about one cycle per hour in infancy (Roffwarg et al, Stern, Parmelee and Harris 1973), Harper, Leake, Miyahara, Mason Hoppenbrouwers, Stenman and Hodgman 1981), although there is disagreement on how early the state cycling becomes stable. Stern et al found cycle-length stability from 36 weeks gestational age, whereas Harper et al suggest that stable sequencing is not evident until three - four months of age.

Most investigators note an increase in frequency and length of episodes of NREM or quiet sleep, and a simultaneous lessening of REM or active sleep in the early months (Roffwarg et al, Harper et al, Thoman 1975). NREM or quiet sleep is thus seen as a mature form of sleep.

It has also been shown that there are consistent individual differences in sleep state organisation. Dittrichova, Paul and Vondracek (1976) found stability from two to 20 weeks in the frequency of rapid-eye movements, regular E.E.G. activity during REM sleep, respiratory rate during quiet sleep, and body movements during REM sleep. Thoman and her colleagues have demonstrated consistency in the mean amounts of time spent in two categories of quiet sleep and three categories of active sleep over two one-hour mid-feed sleep observations in one day (Thoman 1975: Thoman, Korner and Kraemer 1976).

The opportunity to study the contogenesis of sleep organisation at an earlier stage is offered by preterm infants. Parmelee, Wenner, Akiyama, Schultz and Stern (1967) studied infants from 20 weeks gestational age to three months postterm, and noted high levels of active sleep (REM) at early gestational ages, which reduced in preterm subjects to the same levels as fullterm infants by 40 weeks g.a. Active sleep was indistinct until 35 weeks gestational age, at which time most parameters of definition were present. Drefus Brisac (1970) however found that sleep in preterm infants at 38 - 41 weeks was not so well organised as that of fullterm newborns, with fewer correlations among the the components of active sleep, and among those of quiet sleep. Other studies have noted a mixture of mature (long episodes of quiet sleep) and immature (more REM epochs) features of sleep in preterm infants (Stern, Parmelee, Akiyama, Schultz, and Wenner 1969; Booth, Leonard and Thoman

Stern et al (1969) found that the periodicity of quiet sleep and active sleep was the same for preterm and fullterm infants from 36 weeks gestation onward.

Taken together these studies of sleep state indicate that active, or REM sleep, is at higher levels early in infancy than later. Roffwarg <u>et al</u>, as early as 1966, suggested an important function for REM sleep in allowing a necessary discharge of activity in the central nervous system and hypothesised that stimulus of the CNS takes place by the pontine REM mechanism independent of factors external to the CNS. Some support for this functional role of REM sleep is found in the report by Dennenberg and Thoman (1981) that there was a significantly negative correlation between levels of active sleep and the waking state of quiet-alert. Quiet-alert state is typically associated with visual scanning, and the finding suggests that as external stimulation increases, the need for internal CNS stimulation is decreased.

Although the sparse evidence makes this suggestion speculative, there are other findings which indicate an important function for REM sleep. Becker and Thoman (1981, 1982) noted that REM storms (intense bursts of REM activity) were negatively related to a measure of overall state stability in the first five weeks in normal infants. REM storms at six months were negatively related to performance on Bayley MDI scores at one year. The authors suggest that REM storms result from a failure of inhibitory feedback controls in the CNS system, and indicate a general disturbance of CNS organisation; however levels of external stimuli might also be implicated in both REM frequencies and MDI performance, given the demonstrated correlation between quiet-alert and REM-sleep states.

A potent reason for studying sleep state organisation is the possible implication of sleep and respiratory patterns in Sudden Infant Death Syndrome (SIDS). Harper, Leake, Hoffman, Walters, Hoppenbrouwers, Hodgman and Sterman (1981) noted that siblings of SIDS victims had longer intervals between active sleep epochs than controls, and less often entered short waking periods, suggesting failure of the mechanism underlying arousal. Thoman (1975) found that a fullterm infant in her study who died of SIDS had aberrant rates of state change over sleeping and waking behaviour states.

There is thus considerable evidence suggesting that sleep state patterns are related to CNS organisation, and other studies have linked sleep state aberrations with mental retardation (Petre Quadrens 1972) and brain malformation (Monod and Guidasci 1976). The work of Thoman and her colleagues suggests that more subtle aspects of development might be related to sleep state stability, and that waking state organisation is also important as a possible predictor of later functioning.

(2) Studies of Waking States

Most operational classifications of states are based on those of Prechtl (1965) and Wolff (1966), and include two or three sleep states, three waking states, and sometimes an intermediate (drowsy or transitional) state. Differences in numbers of states defined and criteria used in definition have led to confusion and difficulty in research comparisons, though as Korner (1972) pointed out, "it is striking that the overlap of criteria far exceeds the differences" (p 77). A conference with the aim of resolving some of the confusion produced a manual of standardised criteria for describing states, Anders, Emde and Parmelee 1971), and this has provided a basis for more recent research.

The waking states usually defined are quiet-alert (alert inactivity), waking-active, crying, and drowsing. The salience of quiet-alert state has been noted for visual scanning (Korner 1970; Brazelton, Scholl, and Robey 1966). The crying state has a potent effect on maternal attention, usually evoking efforts to calm the infant (for example Brazelton 1982; Rebelsky and Black 1972). Becker and Thoman (1976) noted individual consistency over five weeks in levels of waking-active state and an inverse relationship between waking activity and measures of state stability and suggested that waking-activity is a behavioural state which reflects overall state control.

Thoman and her co-workers have also investigated the predictive nature of state indices of CNS organisation (Thoman, Denenberg, Sievel, Zeidner and Becker 1981) Making the assumption that states are "expressions of fundamental processes in the central nervous system which can be studied by behavioral and/or electrophysiological procedures" (p 46), Thoman et al derived a measure of state profile consistency across five weeks. In a sample of

24 apparently normal infants, seven of nine subjects with the lowest consistency indices developed difficulties by 30 months. Four were developmentally delayed, one died of SIDS, one was excessively hyperactive, and one developed aplastic anaemia. This is somewhat startling evidence of the worrisome aspect of inconsistency of state organisation at the neonatal stage, and reflects CNS dysfunction more than problems of interaction. However in a more obvious way, states such as crying and quiet-alert are intimately involved in social interaction, and aspects of state organisation such as clarity of states, frequency of change, and predictability must have an effect on the caretaking milieu of an infant.

In this regard, one of the most pervasive applications of the concept of state and state organisation has been in the development of the Neonatal Behavioral Assessment Scale (NBAS) (Brazelton 1973). The NBAS is based on a conception of expanding infant organisation, with state differentiation and control being a paramount task in the first weeks of postnatal life, following that of motoric differentiation and control. In discussing the developmental theory implicit in the NBAS, Samaroff (1978) writes

"Before the infant can fully engage its social environment, it must engage in its internal milieu."

And - "In this view the infant can still be seen as a stimulus to the caretaking environment, but the reciprocal influence of the environment is reduced until the newborn has reached a certain level of internal control." (p 112)

If CNS organisation is such that an infant's internal milieu is unstable, then difficulty in engaging it might delay the ability to be responsive to the environment. So a preterm infant for example, whose neurophysiological organisation is likely to be immature, is faced with the problem of internal control over its nervous system at the same time as having, at some level, to engage the social environment before it is ready. By term, in this view, the preterm infant would have had partial success at both. Efforts at internal control would have been undermined by the demands of ex utero life so that one would expect state organisation in these infants to be suboptimal at term. At the same time the ability to receive social stimulation would be reduced since efforts at internal control would still be demanding more attention than in the fullterm normal infant.

An infant who is born at term with a disorganised internal milieu also faces the task of internal control, but has not even the experience of previous environmental stimulation to begin the process of learning to interact. It might, then, take an infant in this category even longer than a preterm counterpart to "engage its social environment" since its first preoccupation will be with achieving a degree of internal organisation. Furthermore, disorganisation in infants born at term might indicate more enduring problems to be overcome since distraction by ex utero stimuli cannot be cited even as a partial cause.

The construct of state then, with its demonstrated relationships with CNS organisation and its influence on social interaction, stands in a bridging position for conceptualising organisation of behaviour in its caretaking context. Research in this area is in its infancy; some studies have demonstrated relationships between the state control dimension of the NBAS and later MDI performance (Sostek and Anders 1977; Vaughn, Taraldson, Crichton and Egeland 1980). However state conceptualisations which embrace interactive dimensions are necessary to describe the transactional nature of development, and the complexity of data and research method required is daunting. Lewis (1972) demonstrates some of these complexities in his analyses of interactions between three month old infants and their mothers. He shows the inadequacy of frequency counts of behaviour in describing individual differences in interaction patterns by showing that the same condition in an infant has widely different consequences. Levels of analysis of data suggested by Lewis will be discussed in another section; one can conclude from his discussion that at the very least, state related variables should be included in consideration of interactions between infants and parents.

IV TEMPERAMENT

The concept of infant and child temperament is part of a more general acknowledgement of the contribution of the infant to its own developmental course. An intuitive awareness in parents of differences among children has always existed. Recent efforts at systematic investigation of the nature and consequences of child temperament find their main source in the New York Longitudinal Study (NYLS) by Thomas, Chess, and Birch (1968) in which children were followed from early infancy to ten years of age. Nine dimensions of reactivity were identified; these were (1) activity level; (2) rhythmicity; (3) approach-withdrawal; (4) adaptability; (5) intensity of reaction; (6) threshold of responsiveness; (7) mood; (8) distractibility; and (9) persistence in behaviour. From these dimensions, clusters of behaviour emerged which have been designated as identifying the easy child, the difficult child, and the slow-to-warm-up child. Five dimensions were seen as salient for the difficult and easy categories. The difficult child was characterised as irregular (arhythmic), withdrawing, slow to adapt, intense, and predominantly negative in mood, while the easy child was seen as being towards the other end of these dimensions.

Thomas et al further suggested that children with a difficult temperament were at greater risk of behaviour disorder because adaptation and socialisation would be more difficult, and because their style of behaviour might undermine the confidence of their mothers in their ability to bring up happy contented children.

Measurement of temperament based on the NYLS dimensions has been developed primarily by Carey and his colleagues (Carey 1970, Carey 1972; Carey and McDevitt, 1978) who designed the Infant Temperament Questionnaire (ITQ) in 1970 and in 1978 the Revised Infant Temperament Questionnaire (RITQ). These, as well as questionnaires for mothers of older children, consist of maternal responses to questions on specific infant and child behaviours designed to tap the dimensions of the NYLS model.

Considerable interest has been taken in the issues which emerge from the concept temperament as a stable and early individual characteristic. Most of the research generated has addressed itself to the operational definition of temperament; however implicit in all investigations is the issue of a theoretical definition. Thomas and Chess (1982) describe temperament as "an actual attribute of the individual (like) motivation or cognition." (p 3). They see temperament as a style of behaviour in the child, which interacts with attributes of parents. "Goodness of fit" between parents and child is suggested as a main factor underlying psychological well-being.

The concept of temperament as being a constitutional or within the individual phenomenon was challenged by Bates (1980) who argued from a review of the research that "difficult" temperament in particular should be treated as a social perception. The ensuing debate (Thomas and Chess 1982; Bates 1982) clearly demonstrates some of the major problems in clarifying the issues surrounding temperament. Conceptual and operational definitions are readily confounded and the evidence cited in both cases is conflicting.

The main focus of the debate and most research concerned with temperament is the validity of the parental rating of infant and child temperament. Even if the assumption of Thomas et al is accepted i.e. that temperament is a constitutional aspect of the individual, can it further be assumed that a maternal report which is most often used in assessment, is an objective measure of temperament?

One approach to this issue is to compare maternal ratings of temperament with observed infant and child behaviour. If specific aspects of infant functioning are reliably related to temperament, then some verification of the objectivity of maternal report is afforded (though of course the constitutional claims for temperament are not tested, since infant "style" is in interaction with maternal factors from the prenatal period onward). Carey (1974) reported a correlation between difficult temperament and night waking in infancy; Samaroff, Seifer, and Elias (1982) found some moderate relationships between NYLS dimensions and infant variables (though maternal characteristics were more powerfully related to ITQ scores). In a study which continuously confused the concepts of maternal perception and infant temperament Campbell (1979) found that infants rated as difficult cried more at three but not eight months, and only when infants at the extreme of difficulty were compared with a control group.

Two studies which found no relationships between temperament ratings and child behaviour are those by Daniels, Plomin and Greenhalgh (1984) and Gordon (1983). Daniels et al compared ratings on the Bayley Infant Behaviour Record (IBR) with difficult temperament scores at twelve and 24 months. However it is unlikely that the assessment of infant functioning in a potentially stressful situation like administration of the Bayley scales would accord with maternal ratings of temperament, particularly as the IBR is based on general impressions by the tester, rather than a range of specific situations like the Infant Temperament Questionnaire. Gordon selected three-and-a-half year old children on the basis of easy and difficult temperament ratings and observed ten minutes of structured play with mothers, finding no differences in child behaviour. Again it is questionable whether sensible comparisons can be made between such short laboratory observations and ratings based on long-term behaviour in a range of specific situations.

The evidence for objectivity of ratings from observations of infant/child behaviour is clearly equivocal. However in general, studies which compare dimensions rather than global ratings and which utilise long rather than short observations, find some relationships between temperamental style and infant or child behaviour. A different aspect of objectivity is addressed if the relationship between temperament ratings and maternal behaviour is considered. If evidence suggests that there is a systematic relationship between them, it cannot be concluded simply that mothers behave differently toward infants of varying temperaments, since maternal behaviour and perceptions may be influencing the very infant behaviour involved in assessing temperament. The most that can be said is that there is some consistency between the mother's report of her infant's temperament, and her behaviour. Gordon (1983) noted several differences in maternal behaviours in the structured observations of three-and-a-half year old children from a range of socio-economic backgrounds. Mothers talked to and used non-power techniques with difficult more than easy children, and showed more dependent behaviour with easy than with difficult children. Campbell (1979) found in her sample of six that mothers were less responsive to infants at four and eight months who were rated adversely, despite no observed differences in infant behaviour at eight months. Milliones in a study of black mothers and children, (1978) reported a negative correlation between perceived child temperament at eleven months and "maternal responsiveness" as rated by family specialists visiting the home.

Klein (1984) compared ITQ ratings by mothers of Israeli infants at six months old with maternal behaviours at six and twelve months. Observations were three to four hours long, duplicated at each age, and done in the infants' homes. Strong relationships were found at both ages between several temperament dimensions related to easiness and maternal social mediation, sensory stimulation, contingent behaviour and aspects of the object environment.

Dunn and Kendrick (1980) compared temperament dimensions with mother-child interactive behaviour in a group of 40 toddlers from working class English homes, and found several expectable relationships between mood, unmalleability, and withdrawing behaviour, and aspects of observed infant and maternal behaviour. Children rated as negative in mood, for example, spent more time close to their mothers and were helped less than others, and comparatively "unmalleable" children followed suggestions less often, interacted less and were helped less than others. Like Klein, Dunn et al carried out observations in the home over a range of situations, rather than drawing on structured observational data.

The evidence for differences in maternal behaviour as a function of maternaly-rated temperament is thus considerable from studies over a range of infant-ages, racial and socioeconomic groups, and observation procedures, although concurrence of findings is not apparent because of the small number of studies attempted and the range of variables used. It is, however, more accurate to view "maternal behaviour" as "interactive behaviour", particularly with variables such as "maternal responsiveness" (Milliones). These studies suggest that it is easier to discern differences in maternal facets of interaction than in infant behaviour, which does not support a view of temperament as a within-the-individual phenomenon. They do not, however, necessarily pass judgement on the objectivity of maternal ratings since it is not clear that studies which failed to find differences in infant behaviour were looking at the same aspects as those tapped by mothers in rating their infants. In fact the demonstrated maternal differences in relation to temperament ratings might be reflecting styles of interaction which develop in response to subtle and relatively stable styles of infant behaviour. Studies which investigate changes in temperament ratings and relevant infant behaviours over time are needed to investigate this possibility.

A measure of the objectivity of maternal ratings of temperament is the extent to which other people agree using the same rating dimensions. Field and Greenberg (1982) compared mothers', fathers', and teachers' ratings of infants and toddlers' temperaments, after the teachers had had four months of extensive contact with the children. Inter-parent agreement was significant on three dimensions for infants, and seven for toddlers and preschoolers. There was little convergence between parents and teachers in infancy, but moderately high convergence at toddler/ preschool level. Dunn and Kendrick also found agreement between mother and observer ratings on six of seven dimensions in two year olds with observers using the same scales as the mothers. Bates (1980), reviewing the evidence available then on mother-father and parent-observer agreement, concludes that "caregiver reports of infant and child temperament are of uncertain relevance to the within-the-individual component of the definition of temperament." (p 306). The Field _et al_ and Dunn _et al_ studies suggest that toddler temperament ratings might have more external validity than infant ratings. If this is so, then the influence of the demonstrated differences in maternal behaviours in infancy renders the assumption that temperament resides strictly in the child even less justifiable.

Thus far the evidence is ambiguous. There is little support for Thomas _et al_'s contention that maternal ratings of temperament represent objectively a within-child factor. There are few findings of concurrent differences in child behaviour, though several studies have found differences in maternal behaviour. Findings of concurrence between parents and observers ratings are also modest.

There are, however, some areas of support for the importance of the concept of temperament as construed by Thomas _et al_ if not for their claims for the objectivity of the maternal rating. Bates (1980) carefully reviewed genetic studies of monozygotic and dizygotic twins, and concluded that despite the problems of perceptual bias, "(this) research suggests that there probably are genetic influences on variables that can be called temperament." (p 301).

Some suggestive support for a constitutional, if not genetic, aspect of temperament comes from another study, by Meares, Penman, Milgrom-Friedman and Baker (1982). Maternal ratings of "expected difficulty" in the newborn were related to state control and physiological response to stress in the infant; and to "coping ability" in the mother. Maternal perception in the neonatal period has been investigated by Broussard and Hartner (1971), who found negative perceptions to be related to later psychological disturbance; this claim is also made for "difficult" temperament by Thomas *et al*. The Neonatal Perception Inventory (NPI) (Broussard and Hartner) used by Meares *et al* asks questions about difficulties in crying, sleeping, feeding, bowel movements and rhythmicity, all of which relate to aspects of Thomas *et al*'s "difficult" category. Meares *et al*'s findings suggest the early confluence of maternal and infant-based factors in forming a maternal perception similar in basis to the temperament concept. Sostek and Anders (1977) also noted a relationship between these early measures. In a study of 18 mothers and infants, the distractibility dimension of the ITQ rated at two weeks was related to state control on the first few days. A study which investigates systematically the relationships between NPI, state stability and temperament, would help to clarify these possibilities.

Furthermore, the lack of support for temperament as a constitutional factor does not deny its potential importance as a stable interactive, or a social-perceptive factory in development. Several investigations have found correlations between perceived temperament and cognitive performance. Sostek and Anders, in the study mentioned above, noted that intensity and distractibility at two weeks were related to ten-week Bayley MDI scores. Field, Hallock, Ting, Dempsey, Dabiri and Shuman (1978), found the Carey temperament rating at four months to be a significant predictor of performance on the Bayley mental and motor scales at twelve months for preterm respiratory distress syndrome and postmature infants. The Field et al study also found that the two risk groups had more adverse temperament ratings at four months than the control group.

Wachs and Gandour (1983) related temperament dimensions at six months to the Infant Psychological Development Scale (IPDS), and found that high intensity and activity were positively related to schemes and gestural imitation, but that intensity, rhythmicity and withdrawal were negatively related to object permanence.

Clearly too few studies in this area are available to evaluate the significance of temperament to cognitive functioning. Intensity, which is a facet of difficult temperament in the Thomas et al concept, is found by both Sostek and Anders, and Wachs and Gandour, to be positively related to at least some aspects of intellectual performance, yet the Wachs et al study indicates that intensity is negatively related to object permanence. Although the Field et al study found a negative relationship between difficult temperament and later performance on the Bayley scales, the finding was for at-risk groups of infants. Daniels et al investigated the relationship of the difficult temperament score (rather than individual dimensions) to Bayley MDI performance, and found no relationships at twelve and twenty-four months.

Apart from intellectual functioning, other important outcome measures have been noted for temperament. Dunn, Kendrick, and MacNamee (1981) reported that intensity, withdrawal, negative mood and unmalleability in first-born two year olds were related to differences in the reaction to the birth of a sibling. Thomas and Chess (1981) found correlations between difficult temperament of three to five years and clinical psychiatric disorder in early adult life, in a follow-up of the NYLS sample. Graham, Rutter and George (1973) noted relationships between low regularity, low fastidiousness, and low malleability and behaviour ratings both concurrent and one year later. Their sample was a group of three to seven-year old children each with one mentally ill parent. These findings thus have to be viewed with caution, especially as the temperament rating scale was not strictly comparable with NYLS based scales.

In a careful study Earls (1981) found that low adaptability, high intensity, and low distractibility in three year-olds were related to behaviour problems as measured by the Behaviour Screening Questionnaire and observation of children's play by clinicians. Low distractibility was identified in this study as having the most significant relationship to behaviour disorder; furthermore, these relationships remained after the bias for parent-child interaction in the questionnaire was removed statistically.

There is, then, evidence supporting the view that temperament construed as an interactive, social-perceptive construct has some importance since relationships have been found with intellectual and behavioural functioning as well as with maternal/interactive behaviour. An important aspect of its usefulness, however, is the reliability of measurement. Graham et al reported low test-retest reliability over a one-month interval for their scale using children from normal families though their scale is not strictly comparable to the NYLS questionnaires. Hubert, Wachs, Peters-Martin, and Gandour (1982), in an extensive review of instruments measuring temperament, report moderately high test-retest reliabilities for most instruments measuring infant and toddler dimensions with a median dimension correlation of .84 for the ITQ and a total-test correlation of .86 for the RITQ. Field et al (1978) found in a sample of 151 infants that those rated difficult on the ITQ at four months were also rated difficult at eight months.

Also, in a sample of 772 infants in Quebec, Maziade, Boudrealt, Thivierge, Capéraa and Coté (1984) measured temperament at four and eight months and found that 70% of difficult and 67% of easy infants remained in the same category across that time.

Hubert et al also report on the stability of dimensions measured from one instrument to the next. Again, moderate stability is reported for most instruments on several individual dimensions. McDevitt and Carey (1981), using a sample of 115 infants, found a significant stability in all temperament dimensions from five months (using the Revised Infant Temperament Questionnaire) to 23 months (using the Toddler Temperament Scale). However Peters-Martin and Wachs (1980) found longtitudinal stability (from six to 12 months) only in activity, rhythmicity, adaptability and mood, using the same scales. Ratings were done by the mothers at both ages. In an earlier study (Carey and McDevitt 1978) the same authors reported on changes in temperament ratings in 187 children from infancy to early childhood. Thirty per cent remained in the same category; a disproportionate number of children rated "difficult" remained in that category; and individual children rated as extreme i.e. easy or difficult tended to move to less extreme positions in early childhood. The investigators also noted that the children who remained in the difficult categories were significantly more active and more negative in mood than those who shifted, while those who shifted from easier categories into difficult categories were significantly more withdrawing than the rest of the sample.

There is thus moderate support for the reliability and stability of temperament ratings. However the lack of evidence and the conflicting results in the areas discussed here indicate that while the concept of temperament is important, further conceptual and operational progress is needed before confidence can be put in its usefulness. Specifically, there is little evidence to support its construal as a constitutional factor; the research reported here indicates the interactional and perceptual nature of the construct. It also suggests its importance as a factor in intellectual and emotional development, and for these reasons further studies are needed which elucidate the ways in which maternal characteristics and perceptions relate to infant style.

CHAPTER II

AIMS, SUBJECTS AND PROCEDURES

It is evident from the review of literature that preterm and SFD infants constitute groups which are at significant risk of later dysfunction; in New Zealand four percent of children are born prematurely, and nine point three per cent are born small for dates (McGee and Silva 1982). Allowing for those which fall into both categories, twelve point one percent of infant births are in these potentially at-risk groups. A major aim of a great deal of research surrounding these infants is to find precise predictors of later difficulties as early as possible, so that assessment and intervention can be instituted when and where it is most likely to be effective.

So far prediction is elusive, particularly for those infants whose only risk factors are prematurity and/or inappropriate growth for age. The statistical link between these factors and developmental aberration is proven, but the mechanisms underlying the developmental processes from birth and determining later optimal or suboptimal functioning are complex and so far largely unmapped. In particular, no investigations to date have studied the early development of SFD infants apart from a few assessments using infant intelligence scales.

This study drew on several areas of previous research, as well as some unexplored assumptions, in defining its aims. It concentrated on extensive observation of comparatively few subjects in order to cover as many aspects of early development as possible.

I AIMS OF THE STUDY

The major aim of the study was exploratory in nature; it sought an understanding of the interplay of several areas of infant development in the first year of life, with the goal of elucidating some of the processes which occur among facets of specified kinds of infants and of their environments. In particular, preterm and small-for-dates (SFD) infants were compared with fullterm counterparts in order to understand aspects of development specific to them. The following areas of development were considered.

(1) Neonatal Behaviour Organisation

The review of literature on state organisation indicates the importance of this dimension in development. The Neonatal Behavioural Assessment Scale would have been pertinent to this study because of the emphasis on state variables; however the need for examiner-training which is not available in New Zealand precluded its use. Instead sleep state organisation was studied in the neonatal period in order to explore its possible relevance to birth status (i.e. preterm, SFD), and to later functioning. Later measures of state stability were also included in interaction observations.

(2) Maternal Perception

Although sparsely explored in the literature, maternal perception of an infant is likely to have a powerful influence on the developing mother-infant interaction and is particularly salient when the infant is compromised by preterm birth or inappropriate growth. An inventory was available which has been suggested to be related to later mental health (Broussard and Hartner 1971); this was used as a measure of maternal perception.

(3) Mother-Infant Interaction

The development of a neonate into a social being is embedded in the relationships developed with the primary caretakers. The role of the father is increasingly acknowledged, but a pragmatic approach to studying the early relationships of infants required focussing on mother-infant interactions since fathers are rarely the predominant caretakers. Typical interaction patterns for fullterm and preterm dyads have been comprehensively investigated (see the review of literature); there have been no studies of the developing interactions of SFD infants and mothers. In this study therefore, two assumptions were tested. The first is that the different balance of interaction for preterm dyads reported in North American studies is universal. The attitudinal differences between British and British-derived populations, and the North American culture are apparent despite a common language. It is possible that these differences affect maternal responses to compromised infants, both indirectly and directly via variations in neonatal unit procedures.

The second assumption is that the developmental course of SFD dyads is the same as that of preterm dyads. Perinatal considerations would suggest that they might be different; the mother of the fullterm SFD infant has carried her foetus the expected length of time, and she may not have had any indication before birth that her infant was anything other than normal. In the hospital from which the subjects in this study were recruited SFD infants were not admitted to the neonatal unit unless sick (all the subjects in the study were healthy). SFD mothers were thus more likely to be with their infant constantly from birth, and were less likely to remain in hospital longer than two weeks, than preterm mothers. Therefore events surrounding birth are different, and other factors such as infant behaviour organisation may combine to influence the development of interaction differentially.

(4) Developmental Assessments

The limitations of infant developmental assessments are discussed in Chapter VI. They do, however, provide an index of current developmental status which, taken with other measures, contributes to later performance. Furthermore the relationships of developmental status with other assessments (particularly interaction variables) provides an important understanding of the interplay of factors in development. Ramey, Farran, and Campbell (1979) reported in their study of low SES mothers and infants that maternal attitudes, behaviour, and interactions accounted for 50 - 60% of the variance in Stanford Binet scores at three years; although these findings and, not be generalisable to other cultures or groups of infants they do indicate the salience of these aspects of development for cognitive performance. Repeated measures also carry more weight than a single assessment and so help to overcome partially the limitations of infant tests in describing groups of subjects in relation to each other.

(5) Perception of Temperament

As discussed in Chapter I, the concept of temperament continues to be investigated at both theoretical and empirical levels. Relationships have been suggested between temperament and maternal behaviour, infant behaviour, maternal perception and developmental status. Few studies have assessed temperament in infants considered at risk: for these reasons then, it was decided to assess infant temperament in this study in order to extend previous findings on interrelationships among the other assessments done and temperament, in fullterm and at risk groups.

II SUBJECTS

All infants were recruited through the neonatal unit and postnatal wards at Christchurch Women's Hospital. All were first-born, in order to avoid the confounding effects of parity.

Mothers were approached by the investigator on the second day after the birth of their infants and, if they showed interest in participation, were left with a letter containing information about procedures and asked to discuss the study with the fathers of the infants.

(1) Pilot Study

Before the initiation of the main study seven infants (four fullterm, three preterm) were recruited for a pilot study in which feasibility of observation procedures and interobserver reliabilities were assessed. In particular the age at which discrimination of sleep states in preterm infants was unequivocal was ascertained, and optimal timing and recording procedures for interaction observations were determined.

(2) Refusal and Attrition

Of a total of 35 mothers approached, four refused to participate (one with a preterm, three with fullterm infants). Two of these felt too overwhelmed by parenthood; one agreed to be involved but was impossible to locate for observations from the start, and the last refused because her husband would not agree.

Three preterm subjects remained in the study for only two or three weeks because they were rehospitalised after discharge with complications which proved to be serious. One SFD subject and her mother were unable to be located after they moved from their flat when the infant was five months. Data are included for this subject to that age. Three preterm infants moved from Christchurch during the study, but it has been possible to complete most assessments during return visits. Finally, one SFD subject was deleted during data analysis when it was realised that she was significantly preterm.

Limited availability of suitable subjects and time restrictions meant that groups were not strictly matched for sex or SES; furthermore group numbers were not as high as originally anticipated. Five sets of twins and one set of triplets were included, partly for intrinsic interest and partly because many suitable preterm subjects were in multiple births. There were thus one fullterm, eight preterm, and two SFD subjects who were twins or triplets. In the following text infants from multiple births are referred to as "twins" for brevity, and in analyses of data where significant differences existed between twin and singleton subgroups of the preterm group singleton data only are used.

(3) Group Characteristics

For the total sample gestational age was calculated from the date of the mother's last menstrual cycle.

Appropriateness of weight for gestational age was based on New Zealand norms developed at the Queen Mary Hospital, Dunedin (1980).

Socioeconomic status (SES) was assessed using the Elley and Irving scale for the New Zealand population (Elley and Irving 1972).

(a) Fullterm Group Infants in this group were first born singletons born at term with no prenatal, perinatal or postnatal complications and with weights above 3000 grams.

(b) Preterm Group All preterm infants were born at or less than 35 weeks gestational age (g.a.) During the time that subjects were being recruited an intermediate nursery was established in which infants who were preterm or SFD but healthy were nursed with minimal intervention by staff, in contrast to the neonatal unit. Fifty per cent of the subjects in the preterm group, who were recruited in the later part of the study, were not therefore admitted to the neonatal unit. Of the other 50%, only three (21.4% of the group) required medical intervention. The policy of the neonatal unit is to encourage maximal involvement by parents in the care of infants.

(c) Small-For-Dates Group All subjects in this group were below the third percentle on the norms for weight for age, and adjusted for maternal height (Buckfield, Clarkson, and Herbison 1983). The third percentile was chosen rather than the tenth percentile which is frequently used in studies, in order to increase the probability that the infants were truly growth-retarded rather than genetically destined simply to be small people. All SFD subjects were healthy and required no medical intervention other than nursing care in the intermediate nursery. It was attempted to recruit subjects born as close to term as possible; however two were born at 36 weeks. None of the mothers smoked during pregnancy.

Table 1 shows additional data for all subjects. Preterm mothers tended to be older and come from a higher socioeconomic grouping than the others; otherwise only the expected group differences of g.a. and infant weight existed.

III PROCEDURES

Detailed accounts of procedures are included in the appropriate chapters; in this section an overall plan of the study is given.

(1) Neonatal Period

Once the co-operation of parents was gained, the mother was interviewed by the investigator in order to obtain information on SES, maternal age, and maternal height. Hospital records were utilised to obtain Apgar scores, gestational age, and infant weight.

It was then arranged to carry out the sleep observations. The initial observation took place in the hospital nursery which was empty since all infants were with their mothers during the day. Subsequent observations took place in the home.

One month after the infant had been discharged mothers were asked to complete the National Perception Inventory (NPI).

TABLE 1

DATA ON THE THREE GROUPS OF INFANTS AND MOTHERS

	GA (WEEKS)	WEIGHT (GRAMS)	APGAR SCORE 5 MINUTES	APGAR SCORE 10 MINUTES	SES*	MATERNAL AGE	MATERNAL HEIGHT (CMS)
FULLTERM	40	range	range	range	range	range	$\bar{X}$ =162.0
N=10		3070-4417	6-9	9-10	3-7	21-27	
(8 male, 2 female)		$\bar{X}$ =3380.2	$\bar{X}$=8.1	$\bar{X}$=9.7	$\bar{X}$ =4.7	$\bar{X}$=23.6	SD =5.7
PRETERM	range	range	range	range	range	range	$\bar{X}$=162.0
N=14	31-35	1440-2350	2-10	6-10	2-5	25-32	
(6 male, 8 female)	33.1	$\bar{X}$=1880.7	$\bar{X}$ =7.8	$\bar{X}$ =9.4	$\bar{X}$ =3.7	$\bar{X}$ =28.9	SD= 6.3
SMALL FOR DATES	range	range	range	range	range	range	$\bar{X}$ =162.5
N=9	36-40	1440-2430	2-9	7-10	1-7	19-33	
(6 male, 3 female)	$\bar{X}$=38.3	$\bar{X}$ =2080.0	$\bar{X}$ =6.6	$\bar{X}$ =9.5	$\bar{X}$ =4.2	$\bar{X}$ =25.3	SD= 4.2

* Lower values mean higher SES levels

(2) Interaction Observations

At two, three, and six months corrected age (for the preterm group) arrangements were made for an observer to visit the home and observe mother-infant interaction while the infant was awake during the morning. Since the observers were known to the mothers from the sleep observations it was comparatively easy to put the mothers at their ease. Emphasis was put on the interest in the infant's day-to-day behaviour, and in practice it was found that the activity required by the mother in bathing the infant tended to distract her attention from the observer.

(3) Developmental Assessments

At four and ten months a trained psychologist, otherwise unconnected with the study and naive to the grouping of the infants, arranged to visit and administer the Bayley Scales of Infant Development, from which the Mental Development Index (MDI) was calculated.

(4) Temperament Ratings and Assessment of Infant Security

During the six-month visits for the interaction observations the Revised version of the Infant Temperament Questionnaire (RITQ) was left with the mothers who were asked to complete and return it. There was 100% return rate. When the infants were one year old the investigator visited the mothers and administered the Flint Infant Security Scale (Flint 1974).

Table 2 gives a chronological presentation of the assessments undertaken.

TABLE 2
CHRONOLOGY OF ASSESSMENTS

AGE OF INFANT	ASSESSMENT
4 days	Observations of sleep
18 days	state organisation*
32 days	
two months	Interaction observation
three months	" "
four months	Bayley MDI
six months	Interaction observation Infant temperament Questionnaire
ten months	Bayley MDI
twelve months	Flint Infant Security Scale

* Preterm infants were observed at 38, 40, and 42 weeks GA

CHAPTER III

SLEEP OBSERVATIONS

I METHOD

All sleep observations were made in the morning, after the infant had been fed. Recording began as the infant went to sleep, which was judged to be when it had been in one of the sleep states for 6 epochs (1 minute) and lasted until a complete sleep cycle had been observed, so long as the infant remained asleep. A sleep cycle consists typically of a long period of quiet sleep followed by a long period of active sleep with or without REM; in infancy initial sleep is often REM sleep whereas in adults onset of REM sleep is not for 50 - 70 minutes after sleeping has begun (Roffwarg et al 1966). In practice recording was continued until it was clear that at least one whole cycle had been completed. The infant was considered to be awake, and the observation terminated, if six successive epochs of wakefulness (one minute) were recorded. The sleep state was recorded every 10 seconds, using a time device connected to an earplug, which indicated 10-second intervals. Observations took place either in the hospital nursery where it was possible for the infant to be alone, or in the home. No adjustments were made to the sleeping positions or routines of the infants; hence the observations were as naturalistic as possible.

1. Sleep State Categories

The following definitions of sleep states were used:

(a) Quiet Sleep (QS). Regular respiration, eyes closed, no body movements, apart from occasional rhythmic mouthing.

(b) Active Sleep (AS) without REM. Irregular respiration, body movements from twitches to full limb and trunk movements, eyes closed, no rapid eye movements.

(c) Active Sleep with REM. Same as AS, but with rapid eye movements occurring during 10-second epochs.

(d) Active Sleep with Dense REM. Active sleep with eye movements occuring at least 50% of the epoch, and possibly eyes opening.

These categories are based on those used by Thoman (1975), but the distinction she made between QSa and QSb, based on rate of respiration, could not be made under the present observation conditions so just one QS catetory was used.

The recordings were made on graph paper so that it was possible to calculate frequencies of states per cycle and also to measure durations of periods and numbers of state changes.

2. Timing of Observations.

Observations were timed in order to be as comparable as possible across groups. The programme of observations for each group was as follows:

(a) Full Term Group: Three observations were done, one within the first four - five days after birth in order to allow recovery from possible effects of maternal medication; the second at 42 weeks and third at 44 weeks.

(b) Preterm Group: All infants were observed at 38, 40 and 42 weeks conceptional age.

(c) Small-for-Dates (SFD) Group: All infants in this group were observed at 40, 42 and 44 weeks conceptional age.

These observation ages were chosen so that infants could be observed as soon after birth as possible.

3. Interobserver Reliabilities

Three observers carried out the observations and interobserver reliabilities attained in training were 95 - 98% (calculated as number of agreements over the number of agreements plus disagreements). Reliabilities were checked every three months, and the mean reliabilities obtained for each state were as follows:

Quiet Sleep:	92.4%
Active Sleep:	88.9%
REM Sleep:	83.8%
DREM Sleep:	88.1%

II RESULTS

Because of the nature of the subjects some of the observations were incomplete, and these were not included for analysis. One fullterm and one SFD infant did not sleep sufficiently long for a complete observation, and one fullterm and one SFD and three premature infants each provided only one complete observation.

Results were analysed for group differences between 40 week observations and means for total observations in the neonatal period. Analysis for intragroup sex differences on the measures showed only three of 30 measures to be significant and these may well be accounted for by uneven group numbers, so data for both sexes are combined. All group differences are expressed as two-tailed t-tests unless indicated otherwise.

1. Frequencies of Sleep States

Table 3 shows the comparative frequencies of sleep states. The results are expressed as frequencies per cycle, which is the percentage of epochs per cycle as measured from QS onset to QS onset.

There were no frequency differences between the preterm and fullterm groups. However the SFD infants had significantly more active sleep without REM than both preterm and fullterm groups, and correspondingly less total REM (though this difference does not reach significance between SFD and fullterm groups).

Frequencies of REM and NREM (quiet sleep and active sleep without REM) are shown in Table 4. The differences between groups were not significant, but SFD infants tended

TABLE 3

COMPARATIVE FREQUENCIES PER CYCLE OF SLEEP STATES IN FULLTERM, PRETERM AND SFD INFANTS (TWO-TAILED T-TEST)

STATE	FULLTERM		SFD		p			FULLTERM		p	PRETERM		SFD		p
	$\overline{X}$	SD	$\overline{X}$	SD		$\overline{X}$	SD	$\overline{X}$	SD		$\overline{X}$	SD	$\overline{X}$	SD	
QUIET SLEEP															
40 weeks	34.9	7.9	33.1	9.0		34.9	7.9	34.5	7.2		34.5	7.2	33.1	9.0	
All combined	36.8	8.2	33.1	7.0		36.8	8.2	34.5	9.4		34.5	9.4	33.1	7.0	
ACTIVE SLEEP Without REM															
40 weeks	16.2	8.1	22.6	9.6		16.2	8.1	17.9	8.7		17.9	8.7	22.6	9.6	
All combined	17.3	8.4	23.3	9.7	.1	17.3	8.4	16.4	6.6		16.4	6.6	23.3	9.7	.02
REM SLEEP															
40 weeks	36.9	8.2	32.7	6.4		36.9	8.2	32.7	7.6		32.7	7.6	32.7	6.4	
All combined	34.0	8.6	31.5	6.4		34.0	8.6	33.5	9.0		33.5	9.0	31.5	6.4	
DENSE REM															
40 weeks	11.9	10.5	11.6	6.6		11.9	10.5	14.9	9.4		14.9	9.4	11.6	6.6	
All combined	11.9	8.9	11.8	6.0		11.9	8.9	15.6	8.6		15.6	8.6	16.8	6.0	
TOTAL REM															
40 weeks	48.8	10.5	44.3	9.6		48.8	10.5	47.6	13.3		47.6	13.3	44.3	9.6	
All combined	45.4	11.9	43.4	9.1		45.4	11.9	49.2	13.6		49.2	13.6	43.4	9.1	.1

TABLE 4
FREQUENCIES OF REM AND NREM SLEEP PER CYCLE FOR FULLTERM, PRETERM, AND SFD INFANTS (NREM INCLUDES QUIET SLEEP AND ACTIVE SLEEP WITHOUT REM)

	REM SLEEP FREQUENCY/CYCLE		NREM SLEEP FREQUENCY/CYCLE	
	$\overline{X}$	S.D.	$\overline{X}$	S.D.
Fullterm				
40 weeks	48.8	10.5	51.1	10.5
total	45.4	11.9	54.1	12.5
Preterm				
40 weeks	47.6	13.3	52.4	12.4
total	49.2	13.6	50.9	13.4
SFD				
40 weeks	44.3	9.6	55.3	10.3
total	43.4	9.1	56.5	9.2

to have more NREM and less REM sleep than fullterm and preterm infants.

2. Cycle Length and Length of Quiet Sleep Periods

Table 5 shows the mean cycle lengths and lengths of quiet sleep periods for the three groups. The preterm group had significantly longer cycle lengths at 40 weeks than the fullterm and SFD groups. The range of cycle lengths was as follows:

Fullterm group	55.3 - 79.5 minutes
Preterm group	54.2 - 90.8 minutes
SFD group	42.5 - 72.3 minutes

Preterm infants also had longer quiet-sleep periods than the other groups at 40 weeks, and than SFD infants when all observations were combined.

3. State Change

The number of state changes per hour and per cycle were calculated. An infant was considered to be in a stable state if it remained in the same state for three consecutive epochs (30 seconds). A measure of unstable state was also made. This consisted of the frequency with which the infant was in a state for two or less epochs. Table 6 shows the group differences for these measures.

There were no between-group differences for unstable state. However there were clear and significant

TABLE 5
CYCLE LENGTH AND LENGTH OF QUIET SLEEP PERIODS FOR FULLTERM, PRETERM, AND SFD INFANTS

STATE	FULLTERM		SFD		p	FULLTERM		PRETERM		p	PRETERM		SFD		p
	$\bar{X}$	SD		SD		$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	$\bar{X}$	SD	$\bar{X}$	SD	
CYCLE LENGTH															
(minutes)															
40 weeks	65.9	7.6	58.8	6.0		65.9	7.6	72.6	14.5	.05	72.6	14.5	58.8	6.0	.05
All combined	62.7	8.08	60.4	9.5		62.7	8.08	64.8	12.7		64.8	12.7	60.4	9.5	
QUIET SLEEP PERIODS															
(minutes)															
40 weeks	18.6	5.3	18.5	3.8		18.6	5.3	22.8	3.5	$^{+}.025$	22.8	3.5	18.5	3.8	$.01^{+}$
All combined	20.8	5.4	19.1	3.7	.1	20.8	5.4	21.1	3.9		21.1	3.9	19.1	3.7	$.05^{+}$

$^{+}$ One-tailed t-test.

TABLE 6

FREQUENCIES OF UNSTABLE STATE AND STATE CHANGE MEASURES FOR FULLTERM, PRETERM, AND SFD INFANTS (ONE-TAILED T-TEST)

STATE	FULLTERM		SFD		p	FULLTERM		PRETERM		p	PRETERM		SFD		p
	$\overline{X}$	SD	$\overline{X}$	SD		$\overline{X}$	SD	$\overline{X}$	SD		$\overline{X}$	SD	$\overline{X}$	SD	
UNSTABLE STATE															
40 weeks	18.7	7.5	18.7	3.8		18.7	7.5	21.1	8.8		21.1	8.8	18.7	3.8	
All combined	18.4	7.8	20.5	6.5		18.4	7.8	19.5	8.2						
STATE CHANGE PER CYCLE															
40 weeks	13.5	8.0	20.5	6.2	.05	13.5	8.0	20.3	8.8	.01	20.3	8.8	20.5	6.2	
All combined	12.7	6.6	19.5	7.8	.005	12.7	6.6	16.7	7.3	.05	16.7	7.3	19.5	7.8	
STATE CHANGE PER HOUR															
40 weeks	12.1	7.5	22.9	6.9	.005	12.1	7.5	17.0	7.9	.01	17.0	7.9	22.9	6.9	.05
All combined	11.5	6.2	20.1	8.8	.005	11.5	6.2	16.4	6.4	.025	16.4	6.4	20.1	8.8	

differences among the groups on the measure of state change. The fullterm infants were more stable in sleep states than either the SFD or preterm infants, and SFD infants were less stable than preterm infants when state change per hour was considered.

III DISCUSSION

1. Frequency of Sleep States

The findings for the preterm and fullterm group accord with those of Parmelee, Wenner, Akiyama, Schultz and Stern (1967), and Booth *et al* that the frequency of sleep states at term for preterm infants is similar to that of fullterm newborns.

SFD infants were differentiated from the preterm and fullterm groups by having significantly more active sleep without REM. The distinction between active sleep without REM and active sleep with REM has been made most consistently by Thoman and her colleagues (Thoman 1975, Thoman *et al* 1976; Booth *et al*) and approximately 20% of total sleeping time appears to be spent in this state of physical activity with no REM. Denenberg and Thoman (1981) made the assumption that the behavioural categories of active sleep including REM and NREM, and quiet sleep were measuring the same neurophysiological processes as the EEG categories of REM and NREM sleep used by Roffwarg *et al*, though Thoman found that two-week old infants spent 69% of total sleeping in active sleep including REM and NREM. Roffwarg *et al*'s value was 48.8%, and Table 4 indicates that this study found the same value if the NREM category includes quiet sleep and active sleep without REM. Thoman's values of 20% for active sleep without REM would indicate that if this state is counted in the NREM category, her values for NREM sleep would be the same as those in Roffwarg _et al_'s study and this one.

The significantly increased amount of active sleep without REM for the SFD infants appears to be at the expense of REM sleep. The importance of REM sleep for endogenous stimulation of the CNS, and discharge of energy, has been suggested by Roffwarg _et al_ (see review section), and supported by evidence of a negative relationship between active sleep and the waking state of quiet-alert (Denenberg _et al_). So although it is probably a primitive stage, as evidenced by its diminuition with age, REM sleep appears to be functional and necessary for normal development in infancy.

Active sleep without REM seems then to be sleep in a hiatus; it shows neither the organisational maturity of quiet sleep nor the internally stimulating function of REM sleep. It might be that SFD infants are in a sense wasting sleep; that their sleep state organisation is less functional than the other infants.

2. Cycle Length and Length of Quiet Sleep Periods

The finding that mean cycle lengths for the fullterm and preterm groups were longer than an hour does not accord with that of Stern, Parmelee and Harris (1973) who have found cycle lengths in neonates to range from 40 to 60 minutes. All observations were made on the first cycle in the morning after the infant fell asleep, and these findings are difficult to explain in view of Roffwarg *et al*'s report that the first sleep cycle in neonates is shorter than subsequent cycles. One possible explain-ation might be that Roffwarg's measurements were made on evening sleep and that shorter morning sleeps may not be subject to such cycle variation.

Booth *et al* noted that a mature feature of the sleep cycle of preterm infants was the presence of longer periods of quiet sleep than term newborns, and those findings are confirmed by this study. SFD infants had similar quiet sleep periods to the fullterm group. However some evidence of the immature nature of the sleep organisation of SFD infants is the finding that when all observations in the neonatal period are taken into account, they have significantly shorter periods of quiet sleep than both fullterm and preterm infants. This finding is not accounted for by the shorter sleep cycles of the SFD group, as correlations between cycle length and length of quiet sleep periods were insignificant or slightly negative for all groups. For individual infants also there was no relationship between cycle length and quiet sleep periods over different observations, nor was there an increase in the length of either with age within the observation period (38 to 44 weeks).

3. State Change

This variable was included as a possible indication of CNS organisational stability, based on Thoman's finding that an infant who subsequently died of SIDS had high rates of state change over sleeping and waking states (Thoman 1975).

Both "at risk" groups in this study had significantly higher rates of state change than the fullterm infants. They shifted more often from state to state, having short bursts of quiet sleep during active sleep periods and correspondingly, more short shifts out of quiet sleep and back during quiet sleep periods. This seems to be an indication of disorganisation which, if paralleled in waking-state changes, would influence parent-child interactions at least in the early stages. Both preterm and SFD infants who might be expected to show a degree of compromise in their neurological organisation, were less stable on this measure.

Some evidence that frequency of sleep state change does affect the mother-child interaction for the preterm infants comes from the fact that this measure at 40 weeks was significantly negatively correlated ($r = -.6019$ $p = .025$) with the Neonatal Perception Inventory (Broussard and Hartner, 1971). Scores for the NPI ranged from minus seven to plus seven, and were converted to positive values (one to 15) for analysis. The Neonatal Perception Inventory (NPI) was administered to the mothers four weeks after the infant was discharged from hospital. No other measure reported here was related to the NPI, and the correlation between it and rate of state change did not exist for the fullterm or SFD groups. The finding suggests, therefore, that the mother's perception of her infant is at least partially affected by behavioural stability in the neonatal period. Most of the preterm infants were kept in the hospital for two or more weeks, during which time the mothers were actively involved in their care. The greater length of exposure for these mothers to their infants may explain the fact that no correlation was found for the other two groups, in which the infants were discharged within a week of birth.

Overall, the findings for the preterm group concur with other investigations. These infants showed a typically mixed pattern of mature and immature features of the sleep cycle, with long quiet sleep periods, long sleep cycles, but comparative instability of state organisation.

The pattern for the SFD group had several aspects which indicate disorganisation of states. The increased levels of "nonfunctional" sleep, tendencies toward shorter cycles and quiet sleep periods, and their significantly greater instability of states, all suggest anomalies of neonatal CNS organisation in these infants.

Stern *et al* note the statistical variability of neurophysiological measures of neonates, and that variability is apparent in these data. Nevertheless, and despite relatively small group numbers, the SFD group show several significant differences from fullterm and preterm infants.

CHAPTER IV

TWO AND THREE-MONTH OBSERVATIONS

1 METHOD

Observations were caried out when the infants were two months and three months old. In the case of the preterm group, these ages were corrected for prematurity. Wherever possible it was arranged with the mother for the observer to be present while the infant was bathed and fed; this entailed arriving before or as the infant woke from a morning sleep, talking briefly with the mother and explaining that we wanted her to proceed as much as possible as if the observer was not present, and asking her not to speak with the observer while recording was taking place. The purpose of the observation was described as being to find out more about what infants do when they are awake and being tended by their mothers.

(1) Length of Observations

This was determined by the circumstances. In many cases, particularly for the two-month appointments, the observation ended when the infant became tired and either fell asleep or was put to bed. In two instances, the observer terminated the observation when the mother became clearly upset by the infant's crying. If, following a bath and a feed, an infant was put on the floor or in a bouncing chair alone, an observation was ended. Often it became obvious that the mother had "finished" dealing with her infant and was waiting for the observer to stop so that she could continue with the housework or other activities. In general, the aim was to record at least 30 minutes of interaction. Mean length of observations were as follows:

Fullterm group:	34.7 minutes (SD 12.9)
Preterm group:	32.4 minutes (SD 10.6)
Small-for-dates group:	35.2 minutes (SD 10.9)

Five observation schedules, two from the fullterm group and three from the small-for-dates group, were unable to be analysed because they were too short. Hence there are a total of 73 interaction observations.

(2) Recording Procedures

Observations were carried out using a device which signalled every ten seconds, the same as that described for sleep observations. It was found during pilot studies that data were lost if continuous recording was attempted; it was decided therefore to alternate ten seconds of observation with ten seconds of recording, on the assumption that frequencies would be evenly distributed through the observation using such comparatively small units of time.

Behaviour was recorded in coded form on a lined sheet divided down the middle for mother and infant. Each line represented a ten-second epoch. To the far right of the sheet the infant's predominant waking state for the epoch was recorded; to the left of this position of the infant. Moving toward the middle of the sheet, the infant's specific activities were recorded. Similarly on the left side of the sheet, the mother's general activity was recorded and specific behaviour noted toward the middle. Wherever it was possible to be certain, the direction of an interaction or sequence of behaviours was indicated.

The following behaviour categories were recorded:

(a) <u>Maternal Behaviour</u>

(i) General activity:

- feed (breast, bottle, spoon)
- change
- dress
- bath

(ii) Position:

- near (within hearing and sight of infant)
- far (out of infant's hearing and sight)

(iii) Specific behaviour:

- vocalise to infant
- look at infant(in a position in which eye contact would take place if the infant looks at mother)
- smile at infant

- kiss infant
- hug
- rock
- tickle
- rub/pat/nonfunctional (affectionate touch)
- rub/pat/functional (usually to "wind" infant)
- play, offer toy
- _vis a vis_ (hold infant in _en face_ position)

(b) Infant Behaviour State:

(i) Quiet Alert: (Q/A)

- eyes alert and focussing or scanning; no movements except mild limb or peripheral movements

Waking Active: (W/A)

- eyes usually open, facial movements, gross limb activity

Drowse: (Dr)

- eyes closed or slowly opening and closing; may be some slow body movement

Fuss/Cry: (F/C)

- Crying predominates throughout epochs.

It was decided, when the infant was feeding, to score the state as Waking Active unless the infant was clearly drowsing (as indicated by sporadic or no sucking and closed eyes), or clearly in the Quiet Alert state (as indicated by focussing, usually on the mother's face).

(ii) Position:

- supine (on floor, table, lap)
- prone
- shoulder (infant held so that it is looking over mother's shoulder)
- standing/lap (standing or being held in standing position on mother's lap)
- sitting lap
- lap/arms (lower part of body on lap; upper part in arms for feeding)
- arms (whole body in arms)
- lap (whole body lying on mother's lap)
- in swing
- in bouncer, etc.

(iii) Specific behaviour:

- look at mother
- vocalise to mother
- vocalise nonspecifically
- fuss (irritated or distressed vocalisation)
- smile
- play/toy
- nipple in (sucking)
- nipple in (sporadic sucking)
- nipple in (no sucking)

Observers also noted, at the end of the observation, features such as apparent irritability of mother, recent vaccinations or mild illnesses of the infant, and subjective impressions of embarrassment or shyness in the mother.

(3) Interobserver Reliability

The observers made several simultaneous observations with the investigator as training sessions, until interobserver reliabilities of better than .70 were achieved (using the formula of number of agreements between observers divided by number of agreements plus disagreements). In practice it was difficult to obtain reliabilities for some behaviours which occurred infrequently or not at all. In passing, it should be noted that these are the behaviours which showed low consistency across two-month and three-month observations for individual infants.

A further problem with obtaining satisfactory interreliability data lies in the fact that simultaneous observations in the field present difficulties with the positions of observers. Sitting rooms and kitchens are often small, and the two observers were likely to have only a partial view of the mother or infant's face. After a simultaneous observation the two observers discussed the data in detail in an effort to remove discrepancies; support for the effectiveness of this is found at least partially in the high consistency correlations found for many measures across two-month to three-month observations.

The following reliabilities were obtained between the investigator and the other major observer for the main interactive categories of behaviour:

Infant	W/A:	94.2%	Mother	look/baby:	89.6%
	Q/A:	84%		voc/b:	86%
	F/C:	100%		smile:	71.4%
	look:	83.3%		hug/kiss:	100%
	vocalise:	83.3%			
	smile:	77%			
	fuss:	100%			

Reliabilities between the author and a second observer who made a small number of observations (6) were somewhat lower for some categories as follows:

Infant	W/A:	92%	Mother	look:	63.6%
	Q/A:	43.5%		vocalise:	76.3%
	F/C:	100%		hug/kiss:	50%
	look:	57.1%		smile:	50%
	vocalise:	60%			
	fuss:	63.6%			
	smile:	60%			

II ANALYSIS OF DATA

The amount of data provided by an interaction schedule of this kind is considerable and many strategies of analysis are possible. For reasons discussed in the literature review, more than just frequency counts are needed in order to approach the subtlety of maternal-infant interaction, as frequency counts usually fail to show differences between groups which, nonetheless, are likely to have differences in patterns of interaction. Michael Lewis (Lewis 1973) suggests four levels of analysis, which were used as a starting point for these data.

They are:

Frequency Distribution: how much of a particular behaviour takes place during an observation, for both mother and infant

Simultaneous behaviour within a ten-second unit (I): the number of ten-second epochs during which an interactive behaviour by mother and infant takes place

Simultaneous behavious within a ten-second unit (II) the nature of the interaction within the epoch e.g. whether the mother vocalises <u>and</u> looks as infant vocalises

Directional interactive analyses: determining, where possible, when behaviour is an initiative or a response to the behaviour of the other.

These variables obtained from the raw data can be assumed under these broad categories, as follows:

(1) <u>Frequency Variables</u>

Because of the varying length of observations, behaviour frequencies are expressed as a percentage of the time of the total observation i.e. the number of epochs in which a specific behaviour occurred divided by the total number of epochs.

Because the main focus of interest was the interactive behaviour of the mother-dyad, an observation was divided into mother-far and mother-near epochs, and the frequency counts based on the mother-near number. Although the amount of time the mother spends away from her infant is of interest itself, it was found that in these comparatively short observations the inclusion of mother-far time was distorting the frequency counts. It was therefore decided to concentrate the analysis on what was happening when the mother was in proximity to the infant.

An observation was also divided into nipple-in and nipple-out epochs. For many infants, especially at two months of age, little or no interaction took place while the infant was feeding and since nipple-in time varied across observations its inclusion would also have distorted the frequency counts. Most of the interaction variables are therefore concerned with nipple-out, mother-near epochs.

The following frequency variables are considered in the results for the two and three-month interaction observations.

(a) Infant Frequencies

W/A (percentage of time in waking-active state)

Q/A (percentage of time in quiet-alert state)

Dr (percentage of time in drowse state)

look-mother

vocalise mother

fuss

smile

(b) Maternal Frequencies

look-infant (nipple out)

vocalise-infant (nipple out)

smile-infant

affectionate behaviour (hug, kiss, rub/pat)

(2) Simultaneous Behaviour

Consonant with the emphasis on interaction, potentially interactive behaviour was included in this category. For the mother this included look, vocalise, affection, and smile; and for the infant look, vocalise, smile and fuss. It can be argued that "fuss", although often initiating a response from the mother, is not strictly an interactive behaviour as it often discourages a maternal response. Maternal response or lack of it to a fussing infant will depend on several factors, including cultural views on whether or not it should be responded to, her tolerance of fussing, and her belief about whether or not it will be decreased or stopped if she does respond. Since there is, then, some confusion about the effect of this behaviour and because it might have distorted the interactive data when it was present in large amounts, simultaneous interactive behaviour was calculated both including and excluding fuss. The two variables in this category are therefore Simultaneous Interactive Behaviour (SIB) and Simultaneous Interactive Behaviour excluding fuss(SIB excl. fuss).

(3) Simultaneous Behaviour II

This category subsumes variables all of which have in common the fact that the behaviour (or absence of behaviour) of both mother and infant are described within the variable. Each variable will be described, with abbreviations used in tables in brackets.

(a) Maternal Interactive Behaviour to Waking-Active (MIB to W/A): the kinds of maternal interactive behaviour described in the frequency counts (look, vocalise, smile, affection) which took place when the infant was in W/A state are expressed as the number of epochs in which any or all occur, divided by the total number of W/A epochs which are nipple-out mother-near epochs, and converted to a percentage.

(b) Maternal Interactive Behaviour to Quiet-Alert (MIB TO Q/A): this is as above, when the infant was in the Q/A state.

(c) Difference Between (a) and (b) (W/A-Q/A MIB Difference): this variable is included as a measure of the extent to which a mother differentially responded to these two states in her infant.

(d) Mother Interactive Behaviour to Infant Look and Infant Vocalise (MIB to L/m, Voc): separate values for MIB to l/m and MIB to voc were calculated during the initial analysis, then combined and averaged to produce this variable expressed as a percentage of the total number of nipple-out mother-near epochs in which the infant looked or vocalised to its mother.

(e) Maternal Interactive Behaviour to Infant Fuss (MIB to Fuss): the percentage of nipple-out epochs in which the mother signalled while the infant was fussing.

(f) Multi-modal Maternal Interactive Behaviour (MIB M-Modal): the percentage of epochs in which the mother's interactive behaviour toward infant-look and infant-vocalise comprised two or more of the described maternal interactive categories.

(g) Maternal Interactive Behaviour Alone (MIB Alone): the percentage of nipple-out mother-near epochs in which any of the mother's potentially interactive behaviour occurred in the absence of any infant-interactive behaviour, regardless of the state of the infant.

(h) Infant-Interactive Behaviour to Mother-Look, Mother-Vocalise (IIB to L/b, Voc/b): the percentages of IIB to mother-look and mother-vocalise were combined and averaged to produce a measure of infant-interaction to these maternal signals.

(i) Multi-modal Infant Interactive Behaviour (IIB M-modal): the percentage of epochs of IIB to l/b, voc/b in which infant interactive behaviour comprised two or more of the described infant-interactive signals.

(j) Mutual Gaze: the percentage of nipple-out epochs in which mother and infant looked at each other.

(k) Synchrony Index (SI): this variable is designed to measure the synchronisation of interactive signalling in the mother-infant dyad, and consists of SIB divided by IIB plus MIB.

(l) Infant Interaction Ration (IIR): a measure of the level of infant interaction, calculated by dividing SIB by IIB plus SIB, thus obtaining the ratio of epochs containing infant behaviour which was actually interactive, to the total number of epochs containing actual and potential infant interactive behaviours.

(m) Maternal Interaction Ratio: the level of maternal interaction, obtained by dividing SIB by MIB plus SIB.

In the presentation and discussion of results, frequency variables are described as such; the two categories of simultaneous variables are presented together as interaction variables. The fourth level of analysis suggested by Lewis, the direction of interaction, was recorded so rarely in the two and three-month observations that it was omitted at those ages.

III RESULTS

(1) Twins and Singletons

Since the preterm group contained a significant number of twins and triplets (referred to for brevity as twins), it was necessary to check for differences between values for twins and singletons. Table 7 shows the twin/

TABLE 7

TWIN-SINGLETON DIFFERENCES FOR INTERACTION VARIABLES: TWO AND THREE MONTH OBSERVATIONS

INFANT FREQUENCIES

		TWINS N=8 $\overline{X}$	SD	SINGLES N=6 $\overline{X}$	SD	p df=12
W/A	2mo	59.4	16.2	47.5	15.2	
	3mo	62.8	25.1	61.5	17.4	
Q/A	2mo	21.3	14.8	27.6	23.1	
	3mo	30.2	21.7	31.7	20.1	
Dr	2mo	4.3	6.1	9.4	11.1	
	3mo	2.1	4.0	3.3	3.0	
F/c	2mo	11.2	10.4	14.5	23.4	
	3mo	4.5	7.1	.96	2.1	
Look	2mo	29.8	15.3	13.3	4.5	.05
	3mo	30.1	18.6	33.2	17.9	
Voc	2mo	6.2	7.5	7.7	9.9	
	3mo	11.2	7.2	10.1	10.3	
Fuss	2mo	8.4	6.0	10.8	8.3	
	3mo	9.1	5.3	11.5	8.0	
Smile	2mo	4.2	6.3	3.2	3.9	
	3mo	11.0	10.6	9.1	2.9	
State	2mo	16.6	6.4	22.1	6.4	.2
Change	3mo	15.9	6.1	20.6	9.6	

MATERNAL FREQUENCIES

		TWINS N=8 $\overline{X}$	SD	SINGLES N=6 $\overline{X}$	SD	p df=12
Smile	2mo	8.8	15.8	3.4	5.2	
	3mo	8.7	11.8	5.3	10.9	
Look	2mo	56.6	13.3	66.7	21.3	
	3mo	39.0	14.8	43.6	24.2	
Voc	2mo	68.0	22.0	68.4	19.3	
	3mo	59.0	12.7	67.0	23.8	
Affect	2mo	14.2	9.9	16.8	9.6	
	3mo	5.6	3.5	5.5	3.4	

INTERACTIVE VARIABLES

		TWINS N=8 $\overline{X}$	SD	SINGLES N=6 $\overline{X}$	SD	p df=12
MIB to	2mo	73.0	19.2	82.5	21.5	
W/A	3mo	67.7	14.1	76.3	21.1	
MIB to	2mo	85.7	10.5	86.6	14.1	
Q/A	3mo	65.4	21.6	69.6	22.4	
Q/A-W/A	2mo	23.0	12.1	9.3	8.8	.05
diff	3mo	20.8	19.6	13.5	11.6	
MIB to	2mo	91.1	13.7	99.3	1.6	
l/m Voc	3mo	83.7	12.9	89.2	17.0	
MIB	2mo	54.2	19.0	65.8	24.1	
m-modal	3mo	75.3	24.4	86.5	18.2	
IIB to	2mo	46.2	24.8	28.1	11.0	.2
l/b Voc	3mo	53.0	20.0	54.7	12.2	
IIB	2mo	11.1	12.6	6.5	6.5	
m-modal	3mo	20.9	10.8	21.8	7.3	
SIB	2mo	34.4	11.4	29.7	7.2	
	3mo	35.0	13.3	38.2	20.2	
SIB	2mo	29.2	12.7	21.8	11.9	
Excl Fuss	3mo	31.1	14.3	31.3	16.1	
SI	2mo	0.82	0.6	0.4	0.2	.2
	3mo	1.3	1.2	1.2	1.0	
IIR	2mo	0.9	0.2	0.96	0.003	
	3mo	0.8	0.1	0.9	.03	
MIR	2mo	0.5	0.2	0.4	0.2	
	3mo	0.5	0.3	0.5	0.2	
IIB	2mo	3.7	6.9	1.0	1.5	
alone	3mo	5.3	4.8	4.4	6.4	
MIB	2mo	40.7	20.6	51.5	10.3	
alone	3mo	27.7	14.3	27.2	6.4	
Mutual	2mo	26.3	13.2	14.3	5.0	.1
Gaze	3mo	22.1	15.4	24.4	14.7	

singleton differences for all variables. (In all tables, two-tailed tests of significance are used). Two two-month variables showed significant differences; they were frequency of infant-look, and the differential maternal interaction levels to W/A and Q/A. Where appropriate, the singleton values have been used for these variables, and for two-month State Change, IIB to l/m, voc, and SI; but in all others twin and singleton data have been combined.

(2) Sex Differences

An analysis of sex differences for all variables was made, and is shown in Table 8. In the frequency variables, maternal look was significantly higher for male than for female infants; males also received more affectionate stimulation, and fussed more than females, whereas female infants tended to be more often in a Drowse state.

The interactive variables showed a greater number of significant sex differences than the frequency data. Maternal differential response to Q/A and W/A was significantly more marked for females than for males; males received more maternal interactive behaviour as they looked and vocalised at three months, and mothers gave significantly more multi-modal stimulation to males at three months. The level of simultaneous interaction behaviour (SIB) for males was significantly higher than for females at two and three months, and slightly less significantly at both ages for SIB excluding fuss.

TABLE 8

SEX DIFFERENCES FOR FREQUENCY AND INTERACTIVE VARIABLES: TWO AND THREE MONTH OBSERVATIONS.

INFANT FREQUENCIES

		FEMALE		MALE		p
		$\bar{X}$	SD	$\bar{X}$	SD	df=32
W/A	2mo	55.7	17.4	62.8	20.8	
	3mo	68.6	22.8	61.4	21.3	
Q/A	2mo	20.5	14.5	21.8	16.3	
	3mo	25.9	18.9	28.2	18.7	
Dr	2mo	6.5	6.8	5.8	9.1	
	3mo	3.0	3.6	1.1	2.1	.1
Look	2mo	21.8	16.5	29.8	18.3	
	3mo	28.9	17.7	35.7	14.5	
Voc	2mo	7.2	6.9	9.4	9.5	
	3mo	11.2	7.5	12.8	9.7	
Fuss	2mo	8.2	7.8	14.4	9.0	.1
	3mo	9.8	6.2	12.4	8.1	
Smile	2mo	3.3	5.2	5.2	6.5	
	3mo	9.0	9.0	9.6	6.7	
State	2mo	16.2	6.9	16.3	8.3	
Change	3mo	15.2	6.3	16.3	8.1	

MATERNAL FREQUENCIES

		FEMALE		MALE		p
		$\bar{X}$	SD	$\bar{X}$	SD	df=32
Smile	2mo	3.6	9.5	8.8	15.1	
	3mo	6.2	10.4	5.7	7.5	
Look	2mo	50.9	26.8	59.9	22.0	
	3mo	36.5	15.4	52.9	21.7	.05
Voc	2mo	62.2	24.0	71.3	18.0	
	3mo	66.0	20.3	70.5	19.8	
Affect	2mo	14.5	10.2	12.3	9.4	
	3mo	4.0	3.2	10.4	12.3	.1

INTERACTIVE VARIABLES

		FEMALE		MALE		p
		$\bar{X}$	SD	$\bar{X}$	SD	df=32
MIB to	2mo	69.7	23.2	82.4	17.6	.2
W/A	3mo	71.0	19.9	81.3	17.3	.2
MIB to	2mo	87.2	13.0	81.5	17.4	
Q/A	3mo	70.4	23.4	77.1	17.3	
Q/A-W/A	2mo	23.0	14.6	12.8	10.0	.05
Diff	3mo	19.0	16.8	11.8	13.1	.2
MIB to	2mo	87.2	18.8	93.1	8.8	
1/m Voc	3mo	79.9	18.3	93.3	7.0	.01
MIB	2mo	73.2	22.9	77.0	21.3	
m-modal	3mo	48.6	24.7	66.4	24.3	.05
IIB to	2mo	37.6	22.6	47.2	21.4	
1/b Voc	3mo	49.2	20.3	56.3	14.2	
IIB	2mo	11.4	12.3	12.2	10.4	
m-modal	3mo	19.0	10.1	24.6	15.2	
SIB	2mo	29.5	13.1	44.2	17.8	.02
	3mo	34.2	9.8	47.5	18.3	.05
SIB excl	2mo	23.5	14.9	33.6	18.0	.2
Fuss	3mo	29.2	10.6	38.8	15.8	.1
SI	2mo	0.63	0.5	1.5	1.8	.1
	3mo	0.94	0.85	1.7	1.3	.1
IIR	2mo	.9	.18	.92	.1	
	3mo	.8	.13	.9	.13	.05
MIR	2mo	.45	.2	.5	.2	
	3mo	.48	.2	.57	.2	
MIB to	2mo	77.0	30.3	80.0	18.2	
Fuss	3mo	74.7	22.2	84.6	26.3	
Mutual	2mo	21.2	12.8	23.7	15.4	
Gaze	3mo	19.7	15.1	30.0	13.5	.1

The Synchrony Index (SI) was higher for mother-son dyads than mother-daughter dyads at two months and three months; mothers tended to interact more with their sons when they were in W/A than with their daughters, at both ages, but mother-daughter dyads had higher frequencies of mutal gaze at two months.

For the purposes of group comparisons of variables, the group most likely to be affected by these differences is the fullterm group as it had a preponderance of male infants. The preterm and small-for-dates (SFD) groups had a fairly even distribution of males and females. Because subject numbers preclude a separate analysis for sex differences, male and female data will be kept together, but note taken where appropriate of the possible effects of these differences.

(3) First Analysis

In the first analysis, group comparisons were made for frequency and interactive variables using corrected ages for the preterm group i.e. ages from expected date of birth.

(a) Infant Behaviour Frequencies Table 9 shows group comparisons for frequencies of infant behaviours at two months.

The preterm group had significantly higher rates of state change than the fullterm group; they tended also to be less frequently in W/A, more often in Drowse, and

TABLE 9
GROUP COMPARISONS FOR TWO MONTH INFANT BEHAVIOUR FREQUENCIES

	FULLTERM		SFD		p	FULLTERM		PRETERM		p	PRETERM		SFD		p
	$\bar{X}$	SD	$\bar{X}$	SD	df=13	$\bar{X}$	SD	$\bar{X}$	SD	df=20	$\bar{X}$	SD	$\bar{X}$	SD	df=20
W/A	70.8	23.0	62.4	14.0		70.8	23.0	55.1	16.3	.1	55.1	16.3	62.4	14.0	
Q/A	19.6	17.3	19.0	7.0		19.6	17.3	23.6	17.6		23.6	17.6	19.0	7.0	
Dr	1.2	3.5	8.5	7.9	.05	1.2	3.5	6.1	8.4	.2	6.1	8.4	8.5	7.9	
F/c	10.3	14.8	11.0	14.9		10.3	14.8	12.4	15.4		12.4	15.4	11.0	14.9	
l/m	26.5	23.9	29.4	18.1		26.5	23.9	+13.3	4.5		23.9**	14.7	29.4	18.1	.1
voc/m	8.9	6.5	12.1	11.0		8.9	6.5	6.7	8.1		6.7	8.1	12.1	11.0	.2
Fuss	15.1	12.1	12.6	8.9		15.1	12.1	9.3	6.7	.2	9.3	6.7	12.6	8.9	
smile	6.1	8.4	3.9	3.6		6.1	8.4	3.8	5.4		3.8	5.4	3.9	3.6	
State change	10.6	7.4	17.1	7.8	.2	10.6	7.4	+22.1	6.4	.02	18.6**	6.7	17.1	7.8	

+Singleton data used
** Twins included, as SFD group included two twins.

to fuss less often than the fullterm infants. However because the fullterm group comprises more boys than girls, the differences between the groups for Drowse and Fuss may be exaggerated as these variables showed significant sex differences, with boys in Drowse less often and fussing more often than girls.

The SFD infants had higher rates of state change than the fullterm group, and were significantly more often in Drowse. Though this difference might be less significant if the preponderance of boys in the fullterm group is accounted for, the comparative strength of the significance suggests that it is a real difference. The SFD group also looked and vocalised to their mothers more often than the preterm infants, and at least half as much as the fullterm group.

Table 10 shows the group comparisons for three-month infant behaviour frequencies.

The differences between preterm and fullterm groups for amounts of W/A, Drowse, and Fuss were no longer significant, but there was still a higher rate of state change for the preterm infants.

At three months the SFD group spent significantly less time in W/A than the fullterm infants (a tendency which was apparent at two months); they had higher rates of Fuss/Cry (F/C) than both fullterm and preterm groups,

TABLE 10

GROUP DIFFERENCES FOR THREE MONTH INFANT BEHAVIOUR FREQUENCIES

	FULLTERM		SFD		p	FULLTERM		PRETERM		p	PRETERM		SFD		p
	$\overline{X}$	SD	$\overline{X}$	SD	df=16	$\overline{X}$	SD	$\overline{X}$	SD	df=22	$\overline{X}$	SD	$\overline{X}$	SD	df=20
W/A	73.7	21.8	54.0.	19.9	.1	73.7	21.8	62.4	21.9		62.4	21.9	54.0	19.9	
Q/A	22.4	20.1	27.0	14.4		22.4	20.1	30.7	20.4		30.7	20.4	27.0	14.4	
Dr	1.0	1.8	8.5	9.9		1.0	1.8	2.5	3.6		2.5	3.6	8.5	9.9	
F/c	2.9	4.0	9.9	10.5	.2	2.9	4.0	3.3	6.0		3.3	6.0	9.9	10.5	.1
l/m	35.3	12.0	36.5	16.4		35.3	12.0	31.2	17.7		31.2	17.7	36.5	16.4	
voc/m	15.2	9.9	11.1	9.2		15.2	9.9	10.8	8.1		10.8	8.1	11.1	9.2	
fuss	12.9	8.3	10.2	7.3		12.9	8.3	10.0	6.2		10.0	6.2	10.2	7.3	
smile	9.2	8.0	8.5	5.9		9.2	8.0	10.4	8.5		10.4	8.5	8.5	5.9	
State Change	12.6	7.4	17.5	6.5	.2	12.6	7.4	17.6	7.5		17.6	7.5	17.5	6.5	

and maintained a higher frequency of state change than the fullterm infants.

(b) Maternal Behaviour Frequencies Table 11 shows group differences for the frequencies of maternal behaviour at two months. There was a tendency for mothers to look more at the preterm infants than at fullterm or SFD infants, and to smile more at fullterm than preterm infants, though none of these differences was significant. No maternal smiling was recorded for mothers of SFD infants at two months.

Table 12 indicates the group differences for maternal frequencies at three months. In the preterm group, mothers looked less and showed less affectionate behaviour toward their infants than in the fullterm group, though these findings are qualified by sex differences in these variables; infant males received more looking and affectionate behaviour than infant females at three months, and males are over-represented in the fullterm group.

Compared with the two-month maternal frequency data, the preterm group shifted its position with regard to maternal looking and affectionate behaviour. At two months mothers of preterm infants looked more at their infants and showed affectionate behaviour more often toward them than mothers in the other groups; at three months this behaviour occurred less often in the preterm than the fullterm and SFD groups.

TABLE 11

GROUP DIFFERENCES FOR TWO MONTH MATERNAL BEHAVIOUR FREQUENCIES

	FULLTERM		SFD		p df=13	FULLTERM		PRETERM		p df=20	PRETERM		SFD		p df=20
	$\overline{X}$	SD	$\overline{X}$	SD		$\overline{X}$	SD	$\overline{X}$	SD		$\overline{X}$	SD	$\overline{X}$	SD	
Smile	13.2	18.6	0.0	0.0		13.2	18.6	6.2	11.4		6.2	11.4	0.0	0.0	
Look	50.9	25.1	53.3	28.8		50.9	25.1	60.2	16.6		60.2	16.6	53.3	28.8	
Voc	65.1	20.4	65.7	27.3		65.1	20.4	68.1	20.4		68.1	20.4	65.7	27.3	
Affect	13.0	12.5	11.9	5.9		13.0	12.5	15.1	9.5		15.1	9.5	11.9	5.9	

TABLE 12

GROUP DIFFERENCES FOR THREE MONTH MATERNAL BEHAVIOUR FREQUENCIES

	FULLTERM		SFD		p	FULLTERM		PRETERM		p	PRETERM		SFD		p
	$\bar{X}$	SD	$\bar{X}$	SD	df=16	$\bar{X}$	SD	$\bar{X}$	SD	df=22	$\bar{X}$	SD	$\bar{X}$	SD	df=20
Smile	5.7	7.9	3.5	3.6		5.7	7.9	7.5	11.2		7.5	11.2	3.5	3.6	
Look	56.4	25.5	47.0	16.4		56.4	25.5	40.6	17.9	.2	40.6	17.9	47.0	16.4	
Voc	72.5	20.9	62.4	31.2		72.5	20.9	61.9	17.0		61.9	17.0	62.4	31.2	
Affect	12.0	14.4	7.0	11.5		12.0	14.4	5.3	3.6	.2	5.3	3.6	7.0	11.5	

(c) <u>Interaction Variables</u> Table 13 shows comparative data for two-month interaction variables. Mothers in the preterm group interacted with their looking and vocalising infants more than mothers of fullterm infants; the frequency of signalling alone was higher for preterm mothers than for either the fullterm or SFD groups. The MIR, which indicates what percentage of maternal interactive behaviour is actually interactive, was lower for preterm mothers than for fullterm mothers.

SFD mothers signalled alone significantly less often than preterm mothers, and the SFD dyads had higher levels of simultaneous interaction than the preterm dyads; they also gazed at each other more often than the preterm group.

There was an overall tendency, though none of the differences were significant, for the SFD dyads to signal at higher levels than fullterm dyads. MIB to fuss, W/A, Q/A, and infant-look and vocalise were greater for SFD than preterm dyads; so were IIB to look and vocalise. These increases are reflected in slightly higher levels of SIB and mutual gaze for the SFD group; however the SI was significantly lower than for the fullterm group.

Table 14 shows the interaction variables at three months. The preterm and fullterm groups had reversed positions for the MIB 1/m, voc and MIB alone variables,

TABLE 13
GROUP DIFFERENCES FOR INTERACTION VARIABLES: TWO MONTHS

	FULLTERM		SFD		p	FULLTERM		PRETERM		p	PRETERM		SFD		p
	$\bar{X}$	SD	$\bar{X}$	SD	df=13	$\bar{X}$	SD	$\bar{X}$	SD	df=20	$\bar{X}$	SD	$\bar{X}$	SD	df=20
MIB to fuss	84.1	13.4	88.0	15.2		84.1	13.4	74.9	29.3		74.9	29.3	88.0	15.2	
MIB to W/A	77.4	17.3	84.6	17.1		77.4	17.3	76.4	19.8		76.4	19.8	84.6	17.1	
MIB to Q/A	80.5	19.4	86.2	17.2		80.5	19.4	86.0	11.4		86.0	11.4	86.2	17.2	
Q/A-W/A MIB diff	15.6	17.2	12.3	6.6		15.6	17.2	+9.3	8.8		+9.3	8.8	12.3	6.6	
MIB to l/m voc	85.2	15.3	93.1	12.3		85.2	15.3	94.0	11.5	.2	94.0	11.5	93.1	12.3	
MIB m-modal	68.1	24.9	77.0	16.5		68.1	24.9	79.3	22.4		79.3	22.4	77.0	16.5	
MIB alone	29.1	18.7	32.6	12.9		29.1	18.7	44.6	18.0	.1	44.6	18.0	32.6	12.9	.2
IIB to l/b voc	41.8	26.0	48.1	22.2		41.8	26.0	+28.1	11.0		39.7**	22.3	48.1	22.2	
IIB m-modal	10.7	9.9	14.7	11.8		10.7	9.9	9.5	10.8		9.5	10.8	14.7	11.8	
IIB alone	3.4	2.4	3.9	5.8		3.4	2.4	-2.7	5.7		2.7	5.7	3.9	5.8	
SIB	42.4	25.5	45.7	13.5		42.4	25.5	32.7	10.1		32.7	10.1	45.7	13.5	.05
SIB excl fuss	30.2	24.8	34.7	16.3		30.2	24.8	26.6	12.5		26.6	12.5	34.7	16.3	
SI	1.7	2.5	0.1	0.5	.2	1.7	2.5	+ .42	0.2		.68**	.5	0.1	0.5	
IIR	0.9	.01	.87	0.2		0.9	.01	0.93	0.1		0.93	0.1	0.87	0.2	
MIR	0.6	0.3	0.5	0.2		0.6	0.3	0.4	.2	.2	0.4	0.2	0.5	0.2	
Mutual gaze	21.1	19.4	26.8	11.6		21.1	19.4	+14.3	5.0		+14.3	5.0	26.8	11.6	.1

+singleton data ** twins included

TABLE 14
GROUP DIFFERENCES FOR INTERACTION VARIABLES: THREE MONTHS

	FULLTERM		SFD		p	FULLTERM		PRETERM		p	PRETERM		SFD		p
	$\overline{X}$	SD	$\overline{X}$	SD	df=16	$\overline{X}$	SD	$\overline{X}$	SD	df=22	$\overline{X}$	SD	$\overline{X}$	SD	df=20
MIB to W/A	86.1	15.0	77.0	24.6		86.1	15.0	70.8	16.6		70.8	16.6	77.0	24.6	
MIB to Q/A	76.3	15.6	82.2	19.2		76.3	15.6	66.8	21.1		66.8	21.1	82.2	19.2	.1
Q/A-W/A diff	11.6	10.2	11.6	16.5		11.6	10.2	18.2	17.1		18.2	17.1	11.6	16.5	
MIB to l/m Voc	90.1	9.4	87.4	19.8		90.1	9.4	85.7	14.1		85.7	14.1	87.4	19.8	
MIB m-modal	59.0	30.3	61.4	31.9		59.0	30.3	58.4	20.8		58.4	20.8	61.4	31.9	
MIB alone	33.5	18.1	28.9	19.2		33.5	18.1	27.5	6.4		27.5	6.4	28.9	19.2	
IIB to l/b Voc	53.3	14.4	56.6	20.2		53.3	14.4	53.6	17.1		53.6	17.1	56.6	20.2	
IIB m-modal	21.0	11.0	27.4	21.5		21.0	11.0	21.2	9.4		21.2	9.4	27.4	21.5	
IIB alone	3.7	4.1	7.2	7.8		3.7	4.1	5.0	5.2		5.0	5.2	7.2	7.8	
SIB	50.1	15.7	43.4	18.1		50.1	15.7	36.1	15.4	.05	36.1	15.4	43.4	18.8	
SIB excl fuss	42.5	11.5	34.6	16.6		42.5	11.5	31.2	14.3	.1	31.2	14.3	34.6	16.6	
SI	1.8	1.4	1.3	0.9		1.8	1.4	1.3	1.1		1.3	1.1	1.3	0.9	
IIR	0.9	0.1	0.8	0.2	.2	0.9	0.1	0.9	0.1		0.9	0.1	0.8	0.2	
MIR	0.6	0.3	0.5	0.4	.2	0.6	0.3	0.5	.2	.2	0.5	0.2	0.5	0.4	
MIB to fuss	91.7	16.7	80.7	33.6		91.7	16.7	73.2	21.5	.05	73.2	21.5	80.7	33.6	
Mutual gaze	29.8	16.2	24.1	14.4		29.8	16.2	23.1	14.6		23.1	14.6	24.1	14.4	

though the differences were not significant. Preterm mothers at three months interacted less with their infants' looking, vocalising and fussing behaviour, and signalled alone less often than the preterm mothers. Preterm SIB levels, which were lower than fullterm, and significantly lower than SFD levels at two months, were at three months significantly lower than the fullterm dyads. This, however, is a variable with significant sex differences so the fullterm value may be inflated by the large number of males in the group. There was also significantly less maternal interactive behaviour when the infant was in W/A for the preterm group than the fullterm group, though this difference as well was probably mediated by the higher number of males in the fullterm group, and the significant difference between males and females on this variable.

There were no longer significant differences in the SI between groups, though the fullterm dyads still tended to be more synchronised than the others. The MIR remained higher for fullterm mothers than preterm mothers, and was also higher at three months for fullterm mothers than for SFD mothers. The IIR was higher, at three months, for fullterm infants than for SFD infants though this result may be influenced by the sex difference in favour of males in this variable.

In this analysis, then, there is evidence that at two months (corrected age) the preterm dyad was characterised by infants who were drowsy, looked, fussed and vocalised less than fullterm and SFD infants, spent less time in W/A, and had a rate of state change higher than fullterm infants. The preterm mothers tended to smile less, but to look and vocalise more toward their infants than their fullterm and SFD counterparts; the lower MIR for these mothers than for the others reflects their efforts to stimulate their drowsy, unresponsive infants. By three months the preterm infants still tended to be more drowsy and to look, vocalise, and fuss less than the fullterm group, but their mothers looked, and vocalised less, and showed less affective behaviour toward them than fullterm mothers. Preterm mothers at three months attempted to interact significantly less when their infants were in W/A than fullterm mothers; The SIB level at three months was significantly lower for preterm than for fullterm dyads, and the MIR continued to reflect the less effective efforts made by these mothers toward their infants.

SFD infants, while significantly more often in Drowse than fullterm infants, looked and vocalised more frequently than fullterm and preterm infants at two months though their rate of state change was higher than that for fullterm infants and about the same as preterm infants. SFD mothers were not recorded as smiling at all at their two month old infants; by three months they were smiling at a level similar to the other groups. Interaction variables at two months showed a contrast between SFD and preterm dyads; preterm mothers signalled alone more than SFD mothers, SFD infants interacted with maternal look and vocalise more frequently than preterm infants. This is reflected in the higher SIB for the SFD dyads, though the lower SI for the SFD group than the fullterm group indicates that SFD mothers and infants were signalling alone more often than fullterm mothers and infants. At three months SFD infants were more often crying and drowsing than the other infants; the frequencies of maternal look and vocalise were intermediate between the fullterm and preterm groups. SIB at three months for SFD dyads was also between the levels of fullterm and preterm dayds, and the IIR indicates that SFD infants' interactive behaviour was not as often coincident with the mothers' as were the fullterm infants. This was also so for the MIR, though the difference between fullterm and SFD SI failed to reach significance.

Overall, then, although SFD infants were potentially more interactive than preterm infants at two and three months, the SFD dyads were not as successful as fullterm dyads in synchronising their interactive signals.

(4) Validation of Data

Although the analyses of group differences show strong trends toward differences, the considerable variance in the data frequently precludes significance. In an attempt to investigate the validity of the data, two steps were taken before a second analysis was performed.

The nature of the observations suggest the possibility that the presence of large amounts of Drowse or fuss/cry might affect the levels of interactive behaviours. Levels of fuss/cry can be considered data in their own right, but it is possible that the timing of an observation i.e. when the infant was just waking, or ready for a sleep, might have elevated the levels of Drowse and thus affected levels of interactive behaviour.

Correlations were therefore carried out between levels of Drowse and fuss/cry, and several infant-frequency, maternal-frequency, and interactive variables. No relationships were found at two months between Drowse and these variables; however at three months there was an inverse relationship with maternal vocalising in the fullterm group and with infant looking in the preterm group, and a positive relationship with maternal looking in the SFD group. These represent six percent of the total correlations with Drowse, so it is unlikely that amounts of this state affected the validity of the observations (see Appendix 1).

Not unexpectedly, levels of fuss/cry were related to several interaction variables at two months. Infant look, infant vocalise, and IIB to l/b, voc. were inversely related for the total sample. MIB to l/m, voc. were inversely related for the fullterm group, and maternal vocalising was positively related for the preterm group. At three months the only relationship was a positive one with SIB in the fulterm group (see Appendix 2). Since an infant is less available for interaction when in Drowse than in fuss/cry, it is pleasing to note few relationships between Drowse and interaction variables; the fact that levels of fuss/cry affect other variables is not surprising and must be considered part of the data.

The second approach to validating the data was to look for consistency across two-month three-month observations for each variable. Table 15 shows the consistency correlations for infant frequency variables. Five of the nine variables showed significant consistency including the directly interactive ones of look and vocalise, the states of W/A and Dr, and frequency of state change. F/c and fuss are related, as fuss behaviour often leads to a state of F/c, and it is probably that both variables are considerably situationally dependent. Environmental factors such as being cold, being undressed, and being bathed before being fed are likely to increase the levels of fuss and F/c, so that consistency across observations may be lowered.

Situational constraints may also explain the inconsistency of Q/A which shows a negative correlation for the SFD group. Q/A is a state which has been shown to be able to be induced by vestibular-propioceptive movement of an infant to a position on the shoulder (Korner and Thoman, 1972). Perhaps it is therefore a more situationally dependent state than W/A or Drowse; it is a subjective impression of the investigator that the presence of objects which encourage scanning behaviour

TABLE 15
CONSISTENCY CORRELATIONS ACROSS TWO MONTH-THREE MONTH OBSERVATIONS: INFANT FREQUENCY VARIABLES

	FULLTERM	PRETERM	SFD	TOTAL SAMPLE
W/A	.3024	.6475***	.7896*	.4645***
Q/A	.3273	.0773	-.6456	.1233
Dr	.2004	.2692	.9288****	.5279****
F/c	.0185	.0729	.5959	.1869
1/m	.4086	.3569	.3297	.3407*
voc	.5356	.3990	.5331	.3975**
fuss	.4349	.3739	.3130	.2831
smile	.2939	.3817	.4680	.1828
State Change	.6364*	.8822*****	.5273	.7360*****

*p=.05
**p=.025
***p=.01
****p=.005
*****p=.0005

induced the Q/A state in the infants and this factor may also have contributed to inconsistency of the variable.

The lack of consistency of infant smile is partially explained by its relationships to W/A and to Q/A. It was positively correlated ($r = .3638$ $p = .05$) to W/A, a state which showed consistency across observations. But it was more significantly negatively correlated ($r = -.4714$ $p = .01$) to Q/A, which was an inconsistent variable. This negative relationship adds some support to the above observation.

Table 16 shows the consistency correlations for maternal variables. Vocalise and affectionate behaviour both showed significant consistencies for the total sample. Maternal look was consistent for fullterm and SFD groups, but not for the preterm group, and smile showed no consistency at all. The inconsistency in smile might be a reflection of the fact that it had the lowest inter-observer reliability for the two main observers. It is difficult to account for the contrast between preterm mothers and the others for maternal look; for the preterm group the frequency of this measure dropped dramatically between two months and three months (see Tables 11 and 12), but it would appear that this decrease was random, rather than related to the mothers' previous level. (Cross lagged correlations between infant two-month frequencies and maternal three-month frequencies failed to show any clear relationships).

TABLE 16
CONSISTENCY CORRELATIONS ACROSS TWO MONTH - THREE MONTH OBSERVATIONS: MATERNAL FREQUENCY VARIABLES

VARIABLE	FULLTERM	PRETERM	SFD	TOTAL SAMPLE N=29
smile	-.3972	-.2068	- +	-.2824
look	.6743*	-.1080	.7474*	.2617
vocalise	.5229	.6917****	.7418*	.6007*****
affection	.7417**	-.3273	.8581***	.3659*

+ Correlation not possible as zero value for one set of figures
*p=.1
**p=.05
**p=.02
****p=.01
*****p=.001

Table 17 shows consistency correlations for interaction variables. Ten of the sixteen showed significant consistencies across the observations for the total sample. MIB to Q/A and W/A-Q/A difference were clearly affected by the inconsistency of frequency of Q/A in the infants. MIB to infant look and vocalise, and multi-modal MIB were consistent for SFD dyads but not for fullterm or preterm dyads; this situation may reflect the fact that maternal frequencies of look and vocalise were both significantly consistent for SFD mothers, whereas only one of each was for preterm and fullterm mothers. The inconsistency of maternal multi-modal behaviours followed from that of MIB to infant look and vocalise, as it was derived from that measure.

IIR was derived from SIB excluding fuss and IIB alone levels. For the SFD group both of these were consistent whereas for the other groups only IIB alone was significantly consistent.

It is interesting to note that nearly twice as many (51.9%) variables were consistent for the SFD dyads as for the fullterm and preterm dyads (29.6%), with many more SFD variables just failing to reach significance. This striking difference between the SFD group and the others will be discussed in a later section. Overall, 62.5% of the variables showed significant consistency for the total sample, and the following analysis is presented taking these into account.

TABLE 17
CONSISTENCY CORRELATIONS ACROSS TWO MONTH - THREE MONTH OBSERVATIONS: INTERACTIVE VARIABLES

VARIABLE	FULLTERM	PRETERM	SFD	TOTAL SAMPLE
MIB to fuss	.0651	.2928	.6158	.3380
MIB to W/A	.4543	.5388**	.9566*****	.6378*****
MIB to Q/A	-.1336	.3623	.6207	.2608
Q/A-W/A diff	.2544	.4592	-.1402	.2265
MIB to l/m voc	-.0876	.1163	.8715***	.3134
M-modal MIB	-.1057	.0410	.8974****	.1769
IIB to l/b voc	.7931***	.5098	.7197*	.6169*****
m-modal IIB	.7257**	.5234*	.6037	.6020*****
SIB	.8725***	.5304*	.6265	.6923*****
SIB excl fuss	.7695**	.5053*	.7407*	.6122*****
SI	.3964	.4355	.7150*	.3942**
IIR	-.3649	-.2104	.9007****	.2741
MIR	.1580	.5694**	.5057	.4479***
IIB alone	.5606	.0567	.9788******	.3496**
MIB alone	.8380****	.4475	.9470****	.5041****
Mutual gaze	.4437	.2456	.3359	.3421*

*p=.1

**p=.05

***p=.02

****p=.01

*****p=.001

******p=.0005

(5) Second Analysis

As described earlier, interaction observations took place at two months and three-months infant age, with ages corrected for prematurity in the preterm group. Arguably, however, it is more appropriate to compare the two-month preterm observations with the three-month fullterm and SFD observations; none of the preterm infants was ill, and all were discharged from hospital at 36-37 weeks gestational age. They therefore had approximately four weeks extra time for the mother-infant relationship to develop. The preterm infants were biologically less mature at two-months chronological age than the fullterm or SFD infants because of their prematurity, and this immaturity was likely to influence their ability to be satisfying partners in the mother-infant dyad; nevertheless it seemed appropriate to make the comparison for uncorrected ages since the length of time the dyads had been together was more comparable. The SFD infants had a mean gestational age of 38.2 weeks at birth and the fullterm infants 39.4 weeks; as the SFD infants tended to be hospitalised a few days longer than fullterm infants because of their size, the comparisons were equivalent.

Further, because of the high levels of consistency for many of the variables, it was decided to combine two-month and three-month values for the SFD and fullterm groups in an attempt to illuminate the more significant differences between them.

Table 18 shows the comparison between fullterm and SFD groups using combined two-month and three-month values, for infant behaviour frequencies and maternal behaviour frequencies. Table 19 compares preterm two-month infant frequencies with fullterm and SFD three-month infant frequencies.

For the preterm group, the differences were broadly the same as the earlier two-month frequency comparisons (Table 9), with some showing greater significance. Table 19 indicates that on state measures, the preterm and the SFD groups were similar, but the preterm infants looked and smiled significantly less often than SFD infants. The preterm infants were in W/A significantly less frequently, were in Drowse and F/c more frequently, and vocalised, smiled and looked significantly less than fullterm infants. Their rate of state change was also higher than the rate for fullterm infants.

The SFD infants looked more, smiled more, and tended to vocalise more than the preterm infants, though overall they spent less time in W/A and more in Drowse than the fullterm infants, a difference in common with the preterm group. This variable showed a significant difference for sex at three months, so the fullterm level may be lowered by the predominance of males in the group; the tendency is likely to be accurate, however.

Table 20 shows comparisons for maternal frequency variables between two-month preterm and three-month

TABLE 18
COMBINED TWO MONTH AND THREE MONTH FREQUENCY VARIABLES FOR FULLTERM AND SMALL-FOR-DATES INFANTS

INFANT FREQUENCIES	FULLTERM $\bar{X}$	FULLTERM SD	SMALL FOR DATES $\bar{X}$	SMALL FOR DATES SD	p df 32
W/A	72.4	21.7	57.9	17.3	.05
*Q/A	21.2	18.4	23.3	11.9	
*Dr	1.1	2.6	8.5	15.2	.05
*F/c	6.2	10.6	10.4	12.3	
1/m	31.4	18.2	33.2	17.0	
voc	12.4	8.9	11.6	9.7	
*fuss	13.9	9.9	11.3	7.9	
*smile	7.8	8.1	6.3	5.6	
State change/ hr	11.7	7.2	17.3	6.8	.05
MATERNAL FREQUENCIES	**FULLTERM $\bar{X}$**	**FULLTERM SD**	**SMALL FOR DATES $\bar{X}$**	**SMALL FOR DATES SD**	**p df 32**
*smile	9.0	13.8	1.5	2.7	.05
*look	54.0	24.8	49.9	22.4	
vocalise	69.2	20.4	63.9	28.5	
affect	12,5	13.2	8.9	10.1	

* Indicates variables which lacked significant consistency across two-three month observations.

TABLE 19

GROUP DIFFERENCES FOR INFANT FREQUENCY VARIABLES: COMPARISON AT THE SAME CHRONOLOGICAL AGE

	FULLTERM		PRETERM		p	PRETERM		SFD		p
	$\overline{X}$	SD	$\overline{X}$	SD	df=22	$\overline{X}$	SD	$\overline{X}$	SD	df=20
W/A	73.7	21.8	55.1	16.3	.05	55.1	16.3	54.0	19.9	
*Q/A	22.4	20.1	23.6	17.6		23.6	17.6	27.0	14.4	
*Dr	1.0	1.8	6.1	8.4	.1	6.1	8.4	8.5	20.3	
*F/c	2.9	4.0	12.4	15.4	.1	12.4	15.4	9.9	10.5	
l/m	35.3	12.0	13.3+	4.5	.01	23.9**	14.7	36.5	16.4	.1
voc	15.2	9.9	6.7	8.1	.05	6.7	8.1	11.1	9.2	
*fuss	12.9	8.3	9.3	6.7		9.3	6.7	10.2	7.3	
*smile	9.2	8.0	3.8	5.4	.1	3.8	5.4	8.5	5.9	.1
State change	12.6	7.4	22.1+	6.4	.05	18.6**	6.7	17.5	6.5	

* Inconsistent variables

\+ Singleton data used

** Twins included, as SFD group includes two twins.

TABLE 20
THREE MONTH MATERNAL FREQUENCIES FOR INFANTS AT THE SAME CHRONOLOGICAL AGE

	FULLTERM		PRETERM		p	PRETERM		SFD		p
	$\overline{X}$	SD	$\overline{X}$	SD	df=22	$\overline{X}$	SD	$\overline{X}$	SD	df=20
Smile	5.7	7.9	6.2	11.4		6.2	11.4	3.5	3.6	
*Look	56.4	25.5	60.2	16.6		60.2	16.6	47.0	16.4	.1
Vocalise	72.5	20.9	68.1	20.4		68.1	20.4	62.4	31.2	
Affect	12.0	14.4	15.1	9.5		15.1	9.5	7.0	11.5	.1

* variables not consistent across observations.

fullterm and SFD groups. Again the differences are similar to those in the earlier two-month frequency comparisons (Table 11), with two trends reaching significance. Mothers in the preterm group looked and behaved affectionately toward their infants significantly more than SFD mothers, and somewhat more than fullterm mothers; since these variables show significant sex differences in favour of boys, the differences between preterm and fullterm mothers may be even greater than these figures indicate. Table 18 indicates the significantly low level of maternal smiling toward SFD infants compared with fullterm mothers; look vocalising and affectionate behaviour were also somewhat lower for SFD mothers than fullterm mothers though differences for look and vocalise were probably low because of sex differences and the preponderance of males in the fullterm group.

Table 21 shows the combined two-month and three-month interaction variables for the fullterm and SFD groups, and Table 22 displays the preterm two-month interaction variables compared with fullterm and SFD three-month interaction variables. Several differences become significant in this analysis. Preterm mothers signalled more than fullterm mothers when their infants were in Q/A; they used more multi-modal interaction behaviour and showed higher levels of signalling in the absence of infant interactive behaviour than fullterm and SFD mothers, however they interacted less with their infants' fussing behaviour. Preterm infants interacted less with their mothers' looking and vocalising, and used

TABLE 21
COMBINED TWO MONTH AND THREE MONTH INTERACTIVE VARIABLES FOR FULLTERM AND SFD DYADS.

INTERACTION VARIABLES	FULLTERM $\bar{X}$	FULLTERM SD	SFD $\bar{X}$	SFD SD	p
MIB to W/A	82.2	16.2	75.9	26.6	
MIB to Q/A	78.2	17.1	87.2	18.4	
W/A-Q/A diff	13.5	13.7	14.0	14.8	
MIB to l/m voc	88.4	12.3	87.4	18.6	
MIB m-modal	63.0	27.6	66.8	26.2	
MIB alone	31.5	18.0	30.6	16.5	
IIB to l/b voc	48.2	20.5	52.3	20.1	
IIB m-modal	16.5	11.5	22.8	18.2	
IIB alone	3.6	3.4	5.7	6.9	
SIB	46.7	20.3	41.9	18.3	
SIB excl fuss	37.1	19.1	32.8	16.8	
SI	1.8	1.9	1.1	0.8	.2
IIR	0.9	.09	0.85	.19	
MIR	0.61	0.2	0.48	0.19	.1
MIB to fuss	67.9	15.2	83.9	26.6	
Mutual gaze	25.4	17.9	25.4	12.8	

less multi-modal interaction, than fullterm and SFD infants. SIB and mutual gaze was significantly lower for preterm dyads than for fullterm and SFD dyads though the difference between the preterm and fullterm groups may be less significant than seems apparent because of the significantly higher levels of SIB for males; they were also significantly less synchronised than both other groups as indicated by the SI. Preterm mothers had a lower MIR than fullterm mothers.

SFD mothers used fewer multi-modal signals and signalled alone less than preterm mothers, and SFD infants had higher levels of multi-modal signalling and signalled alone more than preterm infants. SFD infants also had higher levels of interacting with maternal look and vocalise than preterm infants, and these three characteristics of SFD infants were trends when compared with fullterm infants (Table 15). The SI for the SFD dyads was higher than the preterm but lower than the fullterm dyads, and SFD IIR was lower than preterm IIR. The SFD mothers had a lower MIR than fullterm mothers, but about the same as preterm mothers.

IV DISCUSSION

(1) Preterm Group

Table 19 permits a comparison between preterm and fullterm infant frequencies when the infants were approximately the same chronological age, and had been at home with their mothers for similar lengths of time.

TABLE 22

GROUP DIFFERENCES FOR INTERACTIVE VARIABLES: COMPARISON AT THE SAME CHRONOLOGICAL AGE

	FULLTERM		PRETERM		p	PRETERM		SFD		p
		SD		SD	df=22		SD		SD	df=20
MIB to W/A	86.1	15.0	76.4	19.8		76.4	19.8	77.0	24.6	
*MIB to Q/A	76.3	15.6	86.0	11.4	.2	86.0	11.4	82.2	19.2	
*W/A-Q/A MIB diff	11.6	10.2	+9.3	8.8		**17.7	12.6	11.6	16.5	
*MIB to l/m voc	90.1	9.4	94.0	11.5		94.0	11.5	87.4	19.8	
*MIB m-modal	59.0	30.3	79.3	22.4	.1	79.3	22.4	61.4	31.9	.2
MIB alone	33.5	18.1	44.6	18.0	.2	44.6	18.0	28.9	19.2	.1
IIB to l/b voc	53.3	14.4	+28.1	11.0	.01	**39.7	22.3	56.6	20.2	.1
IIB m-modal	21.0	11.0	9.5	10.8	.02	9.5	10.8	27.4	21.5	.02
IIB alone	3.7	4.1	2.7	5.7		2.7	5.7	7.2	7.8	.2
SIB	50.1	15.7	32.7	10.1	.01	32.7	10.1	43.4	18.8	.1
SIB excl fuss	42.5	11.5	26.6	12.5	.01	26.6	12.5	34.6	16.6	
SI	1.8	1.4	+0.4	0.2	.05	**0.68	0.5	1.3	0.9	.1
IIR	0.9	0.1	0.93	0.1		0.93	0.1	0.8	0.16	.02
MIR	0.6	0.3	0.42	0.2	.05	0.47	0.19	0.42	0.2	
MIB to fuss	91.7	16.7	74.9	24.3	.2	74.9	24.3	80.7	33.6	
Mutual gaze	29.8	16.2	+14.3	5.0	.05	+14.3	5.0	24.1	14.4	.2

*variables not consistent across observations +singleton data used ** twins included for comparison with SFD group

Clearly the mothers in the two groups were dealing with rather different kinds of infants. At this age preterm infants were more often drowsing, fussing, crying, and changing state than fullterm infants; and were less vocal, and looked and smiled less at their mothers. Most studies which have compared preterm and fullterm infant behaviour at this age have used corrected ages; two did not and can therefore be directly compared in this respect; they are by Di Vitto and Goldberg and Crawford. Di Vitto and Goldberg observed only feeding interactions, and found increased levels of fussing and crying for preterm infants at four months; Crawford observed interactions from six months onward and found that preterm infants vocalised less and were more fretful than fullterm infants at six months. Other studies using corrected ages for preterm infants (e.g. Field, 1980, Brown and Bakeman, 1980, Crnic, Ragozin _et al_ 1983) had similar findings, though some (e.g. Minde _et al_, 1983, and Green _et al_ 1983), also using corrected ages, found few or no differences in infant behaviour at three to four months. Table 10, which makes similar comparisons using corrected preterm ages, shows no significant differences in infant behaviour frequencies and suggests that preterm infants in this respect are simply lagging behind in development. At four months chronological age their behaviour was very similar to that of three-month fullterm infants apart from state-change frequencies, and a comparison of Tables 9 and 10 suggests that drowsing, fussing and crying levels were decreasing with maturity as looking, vocalising and smiling increased. It seems, then, that in these respects at least behavioural differences began to decrease between preterm and fullterm infants.

Maternal behaviour at similar infant chronological ages is compared in Table 20. There were no significant differences between preterm and fullterm groups, though a tendency for more affectionate behaviour by preterm mothers accords with Crawford's findings.

More interesting with regard to maternal behaviour is a comparison of Tables 11 and 12, which compare preterm infants with corrected ages. At two months, although the differences were not significant, preterm mothers tended to smile less and look more at their infants than fullterm mothers. By three months however (Table 12), preterm mothers vocalised and looked less, and showed less affectionate behaviour toward their infants than fullterm mothers, while fullterm mothers' levels of looking and vocalising increased from two to three months. This finding for decreased vocalising does not accord with those of Field (1980), or Crnic _et al_, who found that at three and four months preterm mothers vocalised more than fullterm mothers to their infants. These findings suggest that mothers of preterm infants were, by four months, discouraged by their infant's lack of responsiveness and were accordingly decreasing their levels of stimulation.

The results of comparing interaction variables (Table 22) illuminate the difference between groups of dyads to a greater extent than the frequency counts of mothers and infant behaviour alone.

With the infant in W/A state maternal interaction behaviour was lower for preterm than fullterm groups when compared at equivalent chronological ages (Table 22) and at corrected ages (Table 14). Fullterm levels increased from two months to three months, while preterm levels decreased (Tables 13 and 14). For the preterm group this shift was despite the increased frequency of W/A state from two months to three months (Tables 9 and 10). When the infant was in Q/A state maternal interaction behaviour was significantly higher for preterm than fullterm groups (Table 22), though those too decreased from two months to thre months (Tables 13 and 14) so that the level was less for preterm than fullterm groups at corrected ages. Frequencies of Q/A were the same for chronological-age comparisons (Table 19), but, like W/A frequencies, increased from two months to three months for the preterm group (Tables 9 and 10). There is thus a differential response to state in the two groups; over the time between two months and three months fullterm mothers increased their level of responsiveness to Q/A, with parallel small increases in frequency levels of both states in the infants; preterm mothers decreased their levels of responsiveness to both W/A and Q/A, with parallel increases in frequencies of both states in the preterm infants. Since the increases in W/A and

Q/A must have been at the expense of F/c and Dr, this again suggests a delayed response by the mothers to the passivity and crying of the preterm infants at two months.

Although only the preterm decrease in responsiveness to Q/A was significant ($t = 2.9090$ $p = .01$), both decreases suggest that preterm mothers were reducing their levels of stimulation toward their infants over this time, and this is further supported by the decreased level for the preterm group from two months to three months of maternal interaction behaviour to infant look and infant vocalise (Tables 13 and 14). The fullterm group showed a corresponding increase in levels of the same variable, though Table 16 indicates that at the same chronological age there was a tendency for preterm mothers to be higher than fullterm mothers in this regard. The differential change in response between the groups to W/A state is important, as it appears to be related to the developmental quotient at four months (see section on four-month MDI). The explanation for the difference between fullterm and preterm mothers in changing response levels to Q/A is not apparent from these data; Q/A is, however, a state which appears to be associated more with scanning the environment than with interaction with the mother, and it is possible that fullterm mothers were more sensitive than preterm mothers to the need of the infant not to be distracted while scanning. Although preterm mothers decreased their levels of signalling to both W/A and Q/A, this appears to have been part of a general depression of stimulation from two to three months.

However the extent to which they differentiated the states (Q/A-W/A diff) increased somewhat over that time in contrast to the fullterm and SFD groups. This variable was related to MDI scores (see Chapter VI).

At three months chronological age, preterm mothers showed more multi-modal interactive behaviour and signalled alone more frequently than fullterm mothers. These findings support those other studies which found, using corrected ages for preterm infants, that preterm mothers tended to overstimulate their infants (Field 1980), were more active than fullterm mothers in stimulating their infants at three months (Brown et al), and vocalised alone more often (Crnic, Ragozin, et al, 1983). Table 14, however, suggests that levels of multi-modal maternal interaction behaviour and maternal signalling alone were the same for both groups at corrected ages in this study. Again this supports the general finding that preterm mothers decreased their levels of stimulation from two months to three months.

At three-months chronological age, preterm infants had lower levels of interactive behaviour and multi-modal interaction to maternal looking and vocalising than fullterm infants (Table 22). At corrected ages however, (Table 14), preterm levels were equivalent to fullterm levels, supporting the suggestion that preterm infants were lagging behind their fullterm counterparts and were behaving, at four months chronological age, similarly to three-month fullterm infants. Simultaneous Interaction

Behaviour (SIB) levels, however, were significantly lower for preterm dyads than fullterm dyads at both chronological and corrected age comparisons (Tables 22 and 14). Bakeman and Brown (1977) have suggested the concept of a "quota" of interaction held by the mothers. Clearly the preterm dyads had not reached their quota by three months in this sample, and the finding that preterm mothers decreased their levels of interaction suggests that the concept of quota may be a cultural phenomenon.

The Synchrony Index (SI) is an expression of how successful a dyad is at co-ordinating interaction behaviour. The chronological age comparison showed a significant difference between preterm and fullterm groups on this measure, and the significantly lower Maternal Interaction Ratio (MIR) for preterm mothers indicated that asynchrony was determined more by maternal behaviour than by infant behaviour, since the Infant Interaction Ratio (IIR) was the same for both groups. The infants' signals were more often coincident with maternal interaction behaviour, than maternal signals were coincident with infant interaction behaviour.

This finding is congruent with that of Karger (1979) who found higher numbers of Negative Synchrony Patterns (NSP) for dyads in a premature group than a fullterm group. NSP were found to be characterised by high rates of maternal activity and low rates of quiescent states (neither partner acting). These variables underscore more than any other in the investigation the considerable evidence from other studies that mothers of preterm infants try harder, but with less success, to interact their infants than fullterm mothers; in this study however, this appeared to be more so for chronological-age comparisons than for corrected age comparisons, and it appears that preterm mothers began to lower the level of interaction attempts by four months' chronological age.

These data also give strong support for the suggestion that by three months, existing differences in interaction patterms between preterm and fullterm dyads derive more from maternal than from infant behaviours. Table 14, comparing dyads at corrected ages, indicates that there were few differences in infant response levels, and that four-month (chronological age) preterm infants behaved similarly to three-month fullterm infants. Preterm mothers, however, had lower levels of interaction to W/A state and lower MIR variables which influenced SIB levels and synchrony levels of the dyads.

Overall, the interaction observations of this study give broad support to other investigations which have found that in the first three months preterm infants are less responsive partners than fullterm infants, and that preterm mothers make greater, but often less appropriate efforts, to stimulate interaction than do fullterm mothers. These findings are qualified here by data suggesting that between two and three months corrected age preterm mothers reduced their stimulation efforts in ways which might have affected their infants' development relative to fullterm infants, and that they continued to offer inappropriately timed stimulation thus affecting the synchrony and simultaneous interaction levels of the dyad.

(2) Small-for-Dates Group

The results of these analyses indicate that there were some clear differences between the way SFD, and preterm and fullterm dyads developed. SFD infants were more drowsy than both preterm and fullterm infants, yet paradoxically fussed and cried more often; overall they looked, vocalised and smiled more at these ages than preterm infants. So SFD mothers were dealing with somewhat confusing infants who, when not drowsing, were "doing" more than their preterm counterparts, and changing state just as often.

In turn, SFD mothers tended to smile, look, vocalise, and show affectionate behaviour less than fullterm and preterm mothers at two months, and both preterm and SFD mothers tended to lower their frequencies of looking and vocalising from two to three months whereas fullterm mothers increased these levels.

State interaction variables allow a further perspective on these group differences. At two months maternal interaction levels to W/A state were lower for fullterm and preterm groups than the SFD group; the preterm and SFD levels dropped from two to three months whereas the fullterm level rose. However both fullterm and preterm infant frequencies of W/A state rose from two to three months while the SFD infant level fell. Hence the SFD and fullterm maternal interaction levels paralleled the infant state frequency levels, while the preterm maternal levels fell as the infant frequencies rose.

In the rest of the maternal interaction variables (MIB to Q/A, MIB to infant look and vocalise, multi-modal MIB, and MIB alone), the SFD dyads were very similar to fullterm dyads, and were accordingly lower than preterm dyads. The SFD infant interaction variables, however (IIB to maternal look and vocalise, multi-modal IIB, and IIB alone) were significantly higher than the preterm group, and tended to be higher than the fullterm group. IIB alone levels for the SFD infants increased from two to three months, while for fullterm infants they stayed the same. Comparing SFD dyads with preterm dyads, then, SFD mothers made less effort in interaction with their infants than preterm mothers, while SFD infants interacted at a higher level than preterm infants, at the same chronological age. Overall SFD and fullterm dyads were similar on these measures, though SFD infants tended toward higher levels of signalling.

SIB levels for the SFD group were intermediate between preterm and fullterm groups, and the same pattern existed for the Synchrony Index. The IIB and MIR levels suggest, however, that the reasons for lower synchrony in the preterm and SFD groups are different. Tables 13, 14, and 22 show that the IIR for preterm infants was consistently the same as for fullterm infants whereas the MIR for preterm mothers was consistently (and significantly in chronological comparisons) lower than fullterm mothers. Thus synchrony for preterm dyads was probably lowered by the tendency of the mothers to overstimulate their infants. In the SFD group, on the other hand, IIR was consistently lower for SFD infants than for fullterm infants. The MIR was also somewhat lower for the SFD dyads, so that both maternal and infant interaction behaviours contributed to the lower level of synchrony than fullterm dyads achieved.

There emerges from the interaction data a picture of two groups of infants which both show lower interaction levels and less synchronised modes of interaction than fullterm dyads, but which demonstrate rather different interaction patterns. Preterm mothers were developing a relationship with infants who were passive and unrewarding; they in turn were zealous in their attempts to elicit interaction, and the result at these ages was a less synchronised dyad with lower levels of simultaneous interaction than their fullterm counterparts. The SFD infant, on the other hand, was confusing and difficult to "read", with high levels of drowsiness, yet high rates of signalling behaviour. The SFD mother, faced with this kind of infant behaviour, was less eager than the preterm mother in her attempts at interaction, and less successful than the fullterm mother in synchronising her behaviour with that of her infant's. The data suggests, further, that asynchrony and low levels of simultaneous interaction were contributed to in the preterm dyad by low levels of infant interactive behaviour and mistimed maternal signals as expressed by the MIR; whereas in the SFD dyad lower levels of maternal interaction, as well as mistimed infant and maternal interactive behaviours contribute.

In view of the apparent importance of the W/A state (see section on four-month MDI) it is worth noting that for fullterm dyads both infant frequency and MIB level to W/A rose from two to three months. In preterm dyads, infant frequency of W/A rose although MIB to W/A fell. This gives further support to the suggestion that the contribution of the infant to the less optimal functioning of the dyad is greater for SFD than for preterm pairs.

CHAPTER V

SIX-MONTH INTERACTION OBSERVATIONS

I METHOD

The six-month interaction observations were carried out for the preterm group when the infants were six months corrected age. Observations, data collection and analyses were the same as for the two and three month observations. Lengths of observations were as follows:

Preterm group: $\bar{X}$ 37.1 minutes; range 24.3 - 65.0 minutes
Fullterm group: $\bar{X}$ 32.3 minutes; range 26.3 - 44.7 minutes
SFD group: $\bar{X}$ 35.8 minutes; range 21.3 - 49.3 minutes

Observations for all infants were able to be analysed, so that there was a total of thirty-three observations at this age.

Because of developmental changes from three to six months, a few modifications were made to the variables analysed. They are as follows:

(1) Infant Frequencies

The states of drowse and fuss/cry occurred rarely at six months, so were deleted from the analysis. Three variables were added:

(a) look/objects (l/obj): This behaviour was recorded whenever the infant watched toys, or other objects such as a cat, cars moving, etc.

(b) look/observer (l/obs): Six-month old infants showed an active interest in the observer despite attempts to be in a peripheral positon. This behaviour was therefore recorded.

(c) play: This included active manipulation of toys and other objects.

(d) % l/m in Q/A: The frequency with which the infant was in Q/A when it looked at the mother.

(e) % l/obs in Q/A: The frequency with which the infant was in Q/A when it looked at the observer.

(These two variables (d) and (e), were included to test the subjective impression that novel objects and people are observed by an infant predominantly in the Q/A state).

(2) Interaction Variables

Multi-modal interaction variables (MIB, m-modal and IIB m-modal) for mothers and infants were deleted. The variables MIB to look, vocalise and IIB to look, vocalise, were separated into MIB to look, MIB to vocalise, IIB to look, and IIB to vocalise. The following variables were also added, and expressed as frequencies of mother-near time.

(a) MIB to Play: The term "play" subsumes activities in which the infant is absorbed to exclusion of direct interaction with the mother e.g. looking at observer, looking at objects, playing with toys.

(b) Mother Response: It was often possible at this age to determine the direction of an interaction. If the interaction was initiated by the infant, it was called mother response.

(c) Infant Response: A directional interaction initiated by the mother.

(d) Infant Quiescent: **(Infant Q)** The frequency of epochs in which the infant was neither interacting nor playing, attending to the immediate environment, etc.

(e) Mother Quiescent: **(Mother Q)** The epochs in which the mother did nothing directed toward the infant, including feeding, washing, changing, etc.

(f) Both Quiescent: The frequency of epochs in which both mother and infant were quiescent.

(g) Quiet Alert look/mother-look/observer difference: **(Q/A l/m-l/obs diff)**. The difference between the frequency of look/mother in which the infant was in Q/A, and the frequency of look/observer in which the infant was in Q/A.

II RESULTS

All significance levels given are calculated using two-tailed tests.

(1) Twin-Singleton Differences

Variables for the preterm group were analysed for twin-singleton differences. Table 23 shows the results. Twins looked at the observer and looked at objects

TABLE 23

TWIN-SINGLETON DIFFERENCES FOR SIX MONTH FREQUENCY AND INTERACTIVE VARIABLES

VARIABLE (Infant)	TWINS $\bar{X}$	SD	SINGLES $\bar{X}$	SD	p df=12
W/A	79.6	20.0	85.0	9.0	
Q/A	19.5	20.0	14.7	8.4	
Look	24.6	8.1	34.9	23.1	
Voc	16.6	16.1	17.0	11.2	
Look obj	9.7	5.6	4.1	4.0	.1
Look obs	16.2	5.2	7.8	5.4	.02
Play	28.4	16.2	29.6	20.8	
Smile	10.1	10.9	7.8	4.7	
Fuss	6.4	6.3	10.3	9.8	
State Change	9.2	6.9	10.1	6.3	

	TWINS $\bar{X}$	SD	SINGLES $\bar{X}$	SD	p df=12
Maternal look	43.5	26.4	41.4	24.8	
Maternal Voc	48.3	20.0	65.4	31.8	
Maternal Smile	11.8	11.7	.83	1.1	.05
Affect	4.2	3.8	1.3	2.4	.2
MIB to W/A	63.2	24.5	69.5	30.2	
MIB to Q/A	55.5	22.7	62.1	27.6	
MIB to l/m	79.7	18.9	76.3	26.9	
MIB to Voc	80.4	22.4	86.2	16.5	
MIB to Play	31.8	15.6	19.9	14.7	.2
W/A-Q/A diff	11.6	10.9	10.4	7.9	
MIB alone	28.9	18.7	24.6	16.3	
MIR	0.5	0.2	0.6	0.2	
Mother R	3.4	2.2	3.1	1.3	
SI	0.6	0.3	1.0	.4	.05
Mother Q	25.7	17.0	15.7	18.3	

	TWINS $\bar{X}$	SD	SINGLES $\bar{X}$	SD	p df=12
IIB to Voc	45.3	20.4	55.3	23.7	
IIB to Look	47.7	21.2	61.9	22.9	
IIB alone	8.9	9.0	13.0	19.2	
IIR	.75	.2	.79	.2	
Infant R	3.9	4.4	4.2	3.9	
Infant Q	13.8	9.5	14.7	9.8	
Q/A Mother	11.8	16.1	28.0	28.2	.2
Obs diff SIB	27.3	10.5	42.7	10.7	.02
SIB excl Fuss	23.3	9.0	36.3	11.8	.05
Mutual gaze	16.2	11.5	22.9	14.7	
Both Q	4.1	5.3	1.6	2.5	

significantly more often than singletons, and their mothers smiled, showed more affectionate behaviour, and interacted with them as they played more frequently than mothers of singleton infants. The Synchrony Index (S.I.), and levels of simultaneous interaction (SIB and SIB excluding fuss) were higher for singleton dyads, as was Q/A look/mother - look/observer difference. In the group comparisons, singleton values for these variables in the preterm group have been used.

(2) Sex Differences

There were only three variables showing significant sex differences at six months. Male infants fussed more than females ($p = .05$); mothers of males discriminated more between W/A and Q/A ($p = .02$); and mother-daughter dyads had higher frequencies of mutual gaze ($p = .02$). Since these were only 7.7% of all the variables, male and female data were considered together.

(3) Infant Frequencies

Table 24 shows the group differences for frequencies of infant behaviour. Preterm infants looked at their mothers more and at the observer less than fullterm infants, and looked at objects less than the SFD group.

SFD infants were in W/A significantly less often than fullterm infants, and looked at the observer less than the fullterm group. They had higher rates of state change than both fullterm and preterm groups, and looked at objects more frequently than the preterm group.

TABLE 24
GROUP COMPARISONS FOR SIX MONTH INFANT BEHAVIOUR FREQUENCIES.

	FULLTERM		SFD		p	FULLTERM		PRETERM			PRETERM		SFD		p
	$\bar{X}$	SD	$\bar{X}$	SD	df=17	$\bar{X}$	SD	$\bar{X}$	SD	df=22	$\bar{X}$	SD	$\bar{X}$	SD	df=21
W/A	85.6	12.3	73.8	17.7	.2	85.6	12.3	81.9	15.9		81.9	15.9	73.8	17.7	
Q/A	13.0	11.5	19.9	13.3		13.0	11.5	+14.7	8.4		+14.7	8.4	19.9	13.3	
l/m	20.0	12.9	24.0	13.1		20.0	12.9	29.0	16.4	.2	29.0	16.4	24.0	13.1	
voc	21.2	15.9	13.1	11.2		21.2	15.9	16.8	13.7		16.8	13.7	13.1	11.2	
Look obs	14.4	7.2	6.7	3.9	.02	14.4	7.2	+7.8	5.4	.1	+7.8	5.4	6.7	3.9	
look objects	8.4	8.5	10.3	6.8		8.4	8.5	+4.1	4.0		+4.1	4.0	10.3	6.8	.1
play toys	30.6	27.8	28.5	15.5		30.6	27.8	28.9	17.6		28.9	17.6	28.5	15.5	
smile	5.8	6.8	5.3	5.4		5.8	6.8	9.1	8.6		9.1	8.6	5.3	5.4	
fuss	9.8	8.1	8.3	8.4		9.8	8.1	8.1	7.9		8.1	7.9	8.3	8.4	
state change	8.6	6.1	15.8	8.6	.05	8.6	6.1	9.6	6.4		9.6	6.4	15.8	8.6	.1
% l/m in Q/A	16.6	17.8	23.3	24.5		16.6	17.8	18.2	20.2		18.2	20.2	23.3	24.5	
% l/obs in Q/A	39.5	30.3	38.8	31.9		39.5	30.3	57.6	30.9		57.6	30.9	38.8	31.9	

There were no group differences for the percentage of l/m and l/obs that the infants were in in Q/A. However, for the fullterm and preterm infants there was a significant difference (p = .1) between levels of looking at the mother in Q/A and looking at the observer in Q/A. This corroborates the suggestion made earlier than infants were more often in Q/A when looking at novel objects than when interacting with their mothers.

(4) Maternal Frequencies

Table 25 shows differences in these variables. Affectionate behaviour was the only variable to show significant group differences; the preterm mothers had lower frequencies than the fullterm and SFD mothers. Although the differences are not significant, there is a tendency for fullterm mothers to smile more often than SFD and preterm mothers

(5) Interactive Variables

Tables 26 and 27 indicate the group differences for 23 interactive variables.

The preterm dyads had significantly higher levels of simultaneous interaction (SIB and SIB excluding fuss), of mutual gaze, and higher Synchrony Indices than the fullterm dyads. They had lower levels of infant-initiated interactions (mother-response) than the fullterm group, and although differences were not significant preterm mothers tended to interact more with infant vocalising and less with infant play than fullterm mothers. Preterm infants interacted more highly with maternal vocalising

TABLE 25
GROUP COMPARISONS FOR SIX MONTH MATERNAL BEHAVIOUR FREQUENCIES

	FULLTERM		SFD		p df=17	FULLTERM		PRETERM		p df=22	PRETERM		SFD		p df=21
	$\overline{X}$	SD	$\overline{X}$	SD		$\overline{X}$	SD	$\overline{X}$	SD		$\overline{X}$	SD	$\overline{X}$	SD	
look	41.8	24.6	39.5	20.5		41.8	24.6	42.6	24.8		42.6	24.8	39.5	20.5	
vocalise	52.1	26.2	52.5	26.1		52.1	26.2	55.6	26.1		55.6	26.1	52.5	26.1	
smile	5.6	9.9	1.6	2.4		5.6	9.9	+0.83	1.1		+0.83	1.1	1.6	2.4	
affect	5.4	5.0	3.8	3.8		5.4	5.0	+1.3	2.4	.1	+1.3	2.4	3.8	3.8	.2

than fullterm infants.

SFD infants were more often quiescent than fullterm infants. Their mothers differentiated W/A and Q/A more frequently than both fullterm and preterm mothers and there were fewer maternal responses to infant-initiated sequences (mother-response) than there were for the fullterm group.

Compared with preterm dyads, the SFD dyads had lower levels of SIB, SIB excluding fuss, and mutual gaze. The SFD infants interacted less frequently with maternal looking and vocalising than preterm infants, and their mothers interacted with them more often as they played. The S.I. for SFD dyads was the same as the fullterm dyads, and significantly lower than the preterm dyads.

III DISCUSSION

(1) Preterm Group

The few differences in infant behaviour frequencies indicate that by six months, preterm infants were becoming similar to fullterm infants' in frequencies of behaviour. This trend was suggested by the findings in the two and three-month interaction observations. Preterm infants, at six months, looked significantly more often at their mothers than fullterm infants, which is a reversal of the position at three months; they tended to vocalise less often than fullterm infants, but to smile more. Preterm

TABLE 26

GROUP COMPARISONS FOR SIX MONTH INTERACTIVE VARIABLES (I)

	FULLTERM		SFD		p	FULLTERM		PRETERM		p	PRETERM		SFD		p
	$\bar{X}$	SD	$\bar{X}$	SD	df = 17	$\bar{X}$	SD	$\bar{X}$	SD	df=22	$\bar{X}$	SD	$\bar{X}$	SD	df = 21
MIB to W/A	67.8	24.1	69.7	27.4		67.8	24.1	65.9	26.2		65.9	26.2	69.7	27.4	
MIB TO Q/A	60.9	41.3	59.6	33.5		60.9	41.3	61.3	24.8		61.3	24.8	59.6	33.5	
W/A-Q/A diff	11.5	9.1	21.5	18.5	.2	11.5	9.1	11.0	9.1		11.0	9.1	21.5	18.5	.1
MIB to voc.	72.7	24.9	71.1	33.8		72.7	24.9	82.9	19.6		82.9	19.6	71.1	33.8	
MIB to play	24.9	21.0	34.8	16.4		24.9	21.0	+19.9	14.7		+19.9	14.7	34.8	16.4	.1
MIB to look	76.9	21.7	73.8	27.3		76.9	21.7	78.2	21.8		78.2	21.8	73.8	27.3	
MIB alone	30.7	19.0	33.4	18.8		30.7	19.0	27.1	17.2		27.1	17.2	33.4	18.8	
MIB to fuss	78.9	23.3	83.8	24.7		78.9	23.3	68.6	35.9		68.6	35.9	83.8	24.7	
Mother Response	5.9	4.4	3.5	2.9	.2	5.9	4.4	3.2	1.8	.05	3.2	1.8	3.5	2.9	
SI	0.6	0.4	0.6	0.5		0.6	0.4	+1.0	0.34	.1	1.0	0.34	0.6	0.5	.1
Mother Quiesc.	17.4	17.3	12.6	13.2		17.4	17.3	21.4	17.6		21.4	17.6	12.6	13.2	
MIR	0.5	0.2	.5	0.3		0.5	0.2	0.5	0.2		0.5	0.2	0.5	0.3	

+ Singleton values used.

TABLE 27

GROUP DIFFERENCES FOR SIX MONTH INTERACTIVE VARIABLES (II)

	FULLTERM		SFD		p	FULLTERM		PRETERM		p	PRETERM		SFD		p
	$\overline{X}$	SD	$\overline{X}$	SD	df=17	$\overline{X}$	SD	$\overline{X}$	SD	df=22	$\overline{X}$	SD	$\overline{X}$	SD	df=21
IIB to Voc	38.4	17.4	34.6	16.8		38.4	17.4	49.6	21.6	.2	49.6	21.6	34.6	16.8	.1
IIB to Look	46.3	17.7	40.3	16.6		46.3	17.7	53.8	22.3		53.8	22.3	40.3	16.6	.2
IIB alone	12.2	14.8	8.9	11.6		12.2	14.8	10.7	13.8		10.7	13.8	8.9	11.6	
IIR	0.7	0.3	0.8	0.2		0.7	0.3	0.8	0.2		0.8	0.2	0.8	0.2	
Infant R	3.6	3.1	3.6	2.5		3.6	3.1	4.0	4.0		4.0	4.0	3.6	2.5	
Infant Q	11.3	4.9	16.8	7.7	.1	11.3	4.9	14.2	9.3		14.2	9.3	16.8	7.7	
Q/A Mother obs diff	31.7	19.2	29.8	20.8		31.7	19.2	+28.0	28.2		+28.0	28.2	29.8	20.8	
SIB	28.7	14.3	28.0	11.0		28.7	14.3	+42.7	10.7	.1	+42.7	10.7	28.0	11.0	.05
SIB excl Fuss	22.2	11.3	21.6	11.6		22.2	11.3	36.3	11.8	.05	+36.3	11.8	21.6	11.6	.05
Mutual gaze	11.5	10.9	13.2	8.7		11.5	10.9	19.6	12.1	.2	19.6	12.1	13.2	8.7	.2
Both Q.	1.5	1.4	2.8	3.5		1.5	1.4	3.0	4.4		3.0	4.4	2.8	3.5	

+ Singleton values used

mothers, too, looked and vocalised to their infants at the same level as fullterm mothers, though they showed less affectionate behaviour and tended to smile less.

These differences are in only partial agreement with the findings of Crawford who, in a chronological-age comparison at six months, found that preterm infants vocalised less than fullterm infants, but looked at objects more, and fussed and cried more. Preterm mothers showed more afection than fullterm mothers in Crawford's study. However Crnic, Ragozin et al, in an eight-month old corrected-age comparison, found that preterm mothers showed less positive affect than fullterm mothers, and touched their infants more often. The preterm infants in Crnic et al's study vocalised less, but also smiled less, than fullterm infants.

The diferences in interactive variables between the preterm and fullterm groups indicate, however, that the patterns of interaction continued to differ. The preterm infants interacted more with their mothers' vocalising behaviour, and the preterm dyads had higher levels of simultaneous interaction, mutual gaze, and higher values for the Synchrony Index than fullterm dyads. The preterm infants also tended toward higher levels of interaction with maternal-looking, all of which indicates that the members of the preterm dyads were more highly involved with each other than were the fullterm and the SFD dyads at this age.

This contrasts with the three-month pattern, in which the preterm dyads had low levels of simultaneous interaction and synchrony compared with the fullterm group. At three months these low levels were contributed to by low or normal levels of infant interactive behaviour, and low frequencies of maternal behaviour alone. But at six months high levels of infant interaction with maternal looking and vocalising, combined with maternal interactive levels similar to those of fullterm mothers, contributed to high frequencies of simultaneous interaction in the preterm dyads.

(2) Small-for-Dates Group

SFD infants continued, at six months, to have high rates of state change in comparison with the other groups. They spent significantly less time in W/A than fullterm infants, which was also a characteristic of two and three month behaviour. In most other ways their behaviour frequencies were similar to those of the fullterm group, although like the preterm infants they looked at the observer less often.

The mothers in the SFD group also continued to signal at similar frequencies to the fullterm group, as they did in the two and three month observations. The only difference between the groups was in frequency of smiling, though this difference failed to reach significance at six months.

Two of the significant differences for interaction variables between fullterm and SFD groups suggest that the SFD infants were more passive than fullterm infants. They were significantly more often quiescent, and they significantly less often initiated an interaction (mother-response). Further, they tended to interact less with maternal vocalising and looking, and were significantly lower than preterm infants on these measures, and had somewhat lower levels of signalling alone. SFD mothers interacted with their infants as they played significantly more often than preterm mothers and somewhat more often than fullterm mothers; they differentiated W/A and Q/A more often than both other groups. SIB levels, mutual gaze, and S.I. were the same for SFD as for fullterm dyads and lower than preterm dyads, which partially reflects lower levels of infant interactive activity.

At three months the SIB levels for SFD dyads tended to be lower than for fullterm dyads, and the S.I. was significantly lower. SFD maternal interactive behaviour levels were similar to those of fullterm mothers, but SFD infants changed state more often, signalled alone more often, and drowsed more often, so that dydadic synchrony was probably most affected by infant behaviour at that stage. At six months high levels of state change were still evident, and this consistent feature of SFD infants perhaps influenced their mothers in differentiating infant states. It may also be that lower rates of infant interaction to maternal look and vocalise encouraged SFD mothers to interact more frequently with infant play.

Overall, SFD and fullterm dyads interacted at six months in similar ways. The main differences were related to state, with higher rates of change, higher levels of differentiation, and different proportions of Q/A and W/A in the SFD group. Although the SFD infants tended to be somewhat less interactive than fullterm infants, levels of synchrony and simultaneous interaction were the same for SFD as for fullterm dyads.

IV CONSISTENCY OF VARIABLES

Tables 28 and 29 display the consistency correlations for interaction variables from three to six month observations.

(1) Maternal Frequencies

Both looking and vocalising remained consistent, from two to three months (see Table 16), and from three to six months. Preterm mothers from two to three months showed low consistency in looking, which may reflect a lower response level in reaction to their infant's passivity at two months. Fullterm mothers showed the lowest consistencies on these variables from three to six months.

Affectionate behaviour did not remain consistent from three to six months, though it was for fullterm and SFD mothers from two to three months. Again this may reflect a subdued response in the preterm mothers at three months. The lack of consistency to six months for this variable is not surprising, as it subsumes

TABLE 28
CONSISTENCY CORRELATIONS ACROSS THREE MONTH-SIX MONTH OBSERVATIONS: INFANT AND MATERNAL FREQUENCY VARIABLES

VARIABLE	FULLTERM	PRETERM	SFD	TOTAL SAMPLE
Maternal look	.4199	.5423**	.5721	.5081****
Maternal vocalise	.2397	.7150****	.7850**	.5546*****
Maternal smile	-.4475	-.0366	.0873	-.1122
Maternal affect	-.1138	.4538	.1007	.0895
Infant W/A	.2576	.0206	.2415	.2256
Infant Q/A	.1928	-.1753	.6027*	.1249
Infant look	-.4556	.0200	.7987***	.0463
Infant vocalise	.5190	.2360	.3315	.3897**
Infant smile	-.0563	-.1787	-.0966	-.0984
Infant fuss	.2185	.5377**	.0392	.3003*
State change	.0018	.5369**	.2986	.3333*

*p=.1
**p=.05
***p=.02
****p=.01
*****p=.001

TABLE 29
CONSISTENCY CORRELATIONS ACROSS THREE MONTH-SIX MONTH INTERACTION OBSERVATIONS: INTERACTIVE VARIABLES

VARIABLE	FULLTERM	PRETERM	SFD	TOTAL SAMPLE
MIB to W/A	.3950	.7546****	.8005***	.6447*****
MIB to Q/A	.1515	.4543	.4529	.2083
MIB to Fuss	-.2199	.5061	-.3033	.0852
MIB alone	.5473	-.1901	.7347**	.3914**
IIB alone	.5446	.6072**	.7217**	.3886**
MIR	.1034	-.5066*	.4340	-.0908
IIR	.0715	.4165	.8257****	.3958**
SI	-.1848	-.4023	.4785	-.2468
SIB	-.0977	.3147	.4674	.1285
SIB excl fuss	-.2503	.0815	.8825****	-.0282
W/A-Q/A diff	.5067	.0188	.8398****	.3827**
Mutual gaze	-.2146	.1609	.5978*	.0595

*p=.1
**p=.05
***p=.02
****p=.01
*****p=.001

touching, rubbing, and kissing behaviours which are less likely to occur with an active six-month old infant than with an immobile three-month-old. Maternal smile again showed no consistency.

(2) Infant Frequencies

Neither W/A or Q/A states were consistent from three to six months though W/A was from two to three months (see Table 9). It is likely that states become increasingly situationally dependent with age, which would account for the inconsistencies. However, it is of interest to note the comparatively high correlations for Q/A for the SFD group. Between two and three months the relationship is negative; from three to six months it is positive. This combined with the fact that at three and six months the SFD infants showed higher frequencies of Q/A than the other two groups suggests the salience of this state for the SFD infants.

Infant look was not significantly consistent from three to six months for the total sample, though it was for the SFD infants. The difference between the groups is striking; the fullterm infants showed a negative (though not significant) correlation. This indicates a developmental trend away from orientation towards people which is optimal in the early months, but not so in the later months of the first year. However SFD infants showed strong inflexibility in this regard - they continued to look at their mothers at the same rate across these months. The preterm infants appeared to be in a state of flux, with no clear relationship either way.

Infant vocalising was significantly consistent for the total sample as it was from two to three months though values failed to reach significance for any group. Taken with the consistency of maternal vocalisation it seems that levels of vocal interaction were established early and maintained, at least until six months, whereas visual communication changed for the fullterm dyads as the infants became more interested in objects. The preterm infants were the least consistent in vocalising at both two to three months and three to six months.

Infant smile, like maternal smile, showed no consistency at either level. Overall, infant fuss was consistent from three to six months, the only group reaching significance being the preterm infants.

State change was also consistent from three to six months for the total sample, the preterm infants again being the only group to be significantly so in this variable. It is surprising that the SFD infants were not more consistent with State Change, as at six months they maintained high levels of State Change in comparison with other groups. Clearly they do not just change state often; they also tend to vary individually in their rates of change.

(3) Interactive Variables

MIB to W/A was highly consistent from three to six months as it was from two to three months, though in both cases correlations failed to reach significance for the fullterm group. This high level of consistency was despite lack of consistency in the state itself from three to six months, and it is perhaps the clarity of the state which partially explains the finding. There is little doubt when an infant is in W/A, whereas Q/A may be confused in the early weeks with Drowse because of the stillness of the infant. Further, an infant is more likely to be interacting directly with the mother when in W/A than when in Q/A, which is a state more associated with scanning the environment.

MIB to Q/A was not consistent across either time period, and neither was the state itself. Again, however, the SFD group is of interest. From two to three months there was an almost significantly positive correlation for MIB to Q/A, and similarly high negative relationship for the state. The comparative consistency of SFD mothers toward Q/A is probably explained by their high interactive consistency overall between two and three months, expressed by MIB to infant look and vocalise, as there was no consistency in their differentiation of states (W/A - Q/A difference) at this stage. However the SFD group showed high consistency on this state differentiation variable from three to six months, which suggests that the high levels and consistency of Q/A over these months makes it easy for them to recognise and respond differentially to Q/A and W/A in comparison with the mothers in the other groups.

Maternal interaction to infant fuss showed no consistency either from three to six months or from two to three months, though the preterm group was significantly consistent by itself.

MIB alone was consistent from three to six months, as it was from two to three months. However at both stages the preterm mothers were comparatively inconsistent, especially from three to six months, which may reflect their confused response to two-month infant passivity.

IIB alone was consistent overall for both stages, with all groups having positive correlations from three to six months. The two to three month pattern indicates that only the SFD infants were consistent on this measure from two months onward; the fullterm infants had a negative correlation which may indicate their comparatively early ability to discern a lack of response.

The MIR is an index of maternal interaction with infant signals compared with overall maternal signalling, and is a measure of maternal responsivity. From three to six months for the total sample there was no consistency, but for the preterm group there was a significantly negative relationship. Responsive mothers at three months became less responsive at six months, while unresponsive mothers at three months became more responsive. This may again be an example of the confused patterns of the interaction for the preterm dyads with early infant passivity affecting mothers differentially, some drawing back and responding when their infants signalled, and others becoming more active in their attempts to stimulate their infants. From two to three months the preterm mothers were significantly consistent in their levels of responsivity; the differential changes appeared to occur after three months. Fullterm mothers on this measure were conspicuously inconsistent.

The IIR is a similar measure of infant responsivity. It showed consistency from three to six months overall, and in particular for the preterm and SFD infants. From two to three months the SFD infants were highly consistent on this measure, the other two groups showing somewhat negative relationships which might suggest their comparative flexibility in responses to maternal signals.

The Synchrony Index, which indicates the level of synchronisation of mother and infant signals, was inconsistent from three to six months though consistent from two to three months. The synchrony of the dyad is particularly important in the early months when communication skills are developing, and it is not surprising that by six months it shows little consistency. It is again of interest to note that the SFD dyads showed the highest consistency levels at both stages, reaching significance from two to three months and having the only positive relationship from three to six months.

Levels of simultaneous interaction behaviour (SIB), both including and excluding fuss, were inconsistent from three to six months though highly consistent from two to three months. Like the Synchrony Index, SIB is a variable subject to developmental influence and levels of simultaneous interaction are likely to drop as the infant takes more interest in objects in the environment. For the fullterm and preterm groups, the changes in levels for individual dyads appeared to be random whereas the SFD group again demonstrated high levels of consistency on the SIB measure excluding fuss.

The state differentiation variable (W/A - Q/A difference) was consistent for the total sample from three to six months, though not for the preterm group alone. As mentioned earlier, the high consistency for the SFD group may be influenced by the high levels and consistency of Q/A across the period.

Mutual gaze was significantly consistent for the SFD group from three to six months, but not for the other groups. It showed consistency for the total sample from two to three months; again a developmental perspective suggests that this dyadic measure is appropriate at two to three months but less so at six months; the change in levels is random for fullterm and preterm groups but consistent for the SFD dyads.

The surprising aspect of these findings is that so many variables were consistent from three to six months (ten of twenty-three for the total sample). However not one variable was significantly consistent for the fullterm group, though from two to three months eight variables were. This finding underscores the difficulties inherent in trying to identify continuities of development even in the first six months; discrete variables, even interactive variables, change in their salience for development. Hence prediction based on such variables cannot utilise frequency levels, but must take into consideration both the ways in which they change, and the ways in which those changes are most optimally related to current development.

It is clear from these findings that the two groups which, at this stage, were not developing as well as the fullterm infants, were much more consistent and less flexible in their interactive behaviour. In particular the SFD dyads showed almost twice the level of consistency from two to three months as the other two groups; from three to six months the preterm group approached the SFD level (eight variables consistent compared with SFD group's ten).

These data alone do not indicate levels of frequencies which might be best suited to concurrent development. They do, however, suggest that the capacity for change and adaptation within a dyad in the first six months is less in preterm and particularly in SFD pairs than it is for fullterm pairs.

V INTERACTION OBSERVATIONS: GENERAL DISCUSSION

It is clear from the data presented that preterm and small-for-dates infants interact in different ways at different ages with their mothers and that the resulting dyadic patterns vary. From these results it is possible to present two general models of the developing interactions for each group.

(1) Preterm Interaction Patterns

Figure A depicts a process of interaction for the preterm group, utilising trends as well as significant differences, and using the terms "high", "normal", and "low" as comparisons with fullterm group values. At two months, high maternal activity combined with low infant activity to produce low levels of synchrony and of simultaneous interaction. At three months as infant activity levels became similar to those of fullterm infants, maternal activity levels dropped producing, again, low levels of simultaneous interaction and synchrony. At six months maternal levels of activity were almost the same as those of fullterm mothers, however infant interactive behaviour levels were high, contributing to high frequencies of simultaneous interaction.

Comparisons with other studies are difficult, because observation ages and situations are different,

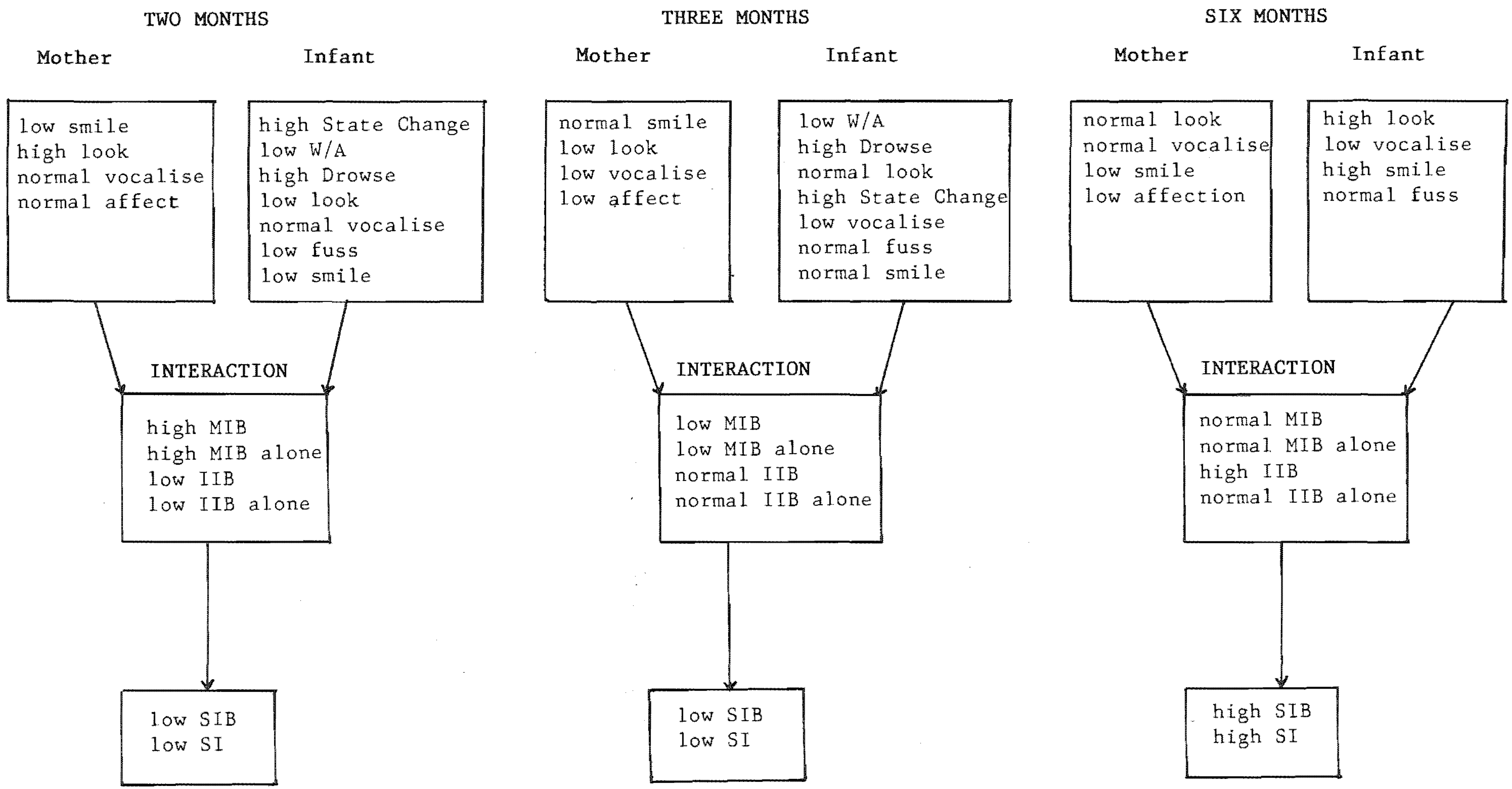


FIGURE A : PATTERNS OF INTERACTION FOR PRETERM INFANTS AT TWO, THREE AND SIX MONTHS as are specific variables. This model depicts the preterm infant as being initially unresponsive, but by three months approaching levels of interaction similar to full-term infants, a finding broadly in concordance with those of Di Vitto _et al_, Greene _et al_ and Minde _et al_ for healthy preterm infants. However the finding in this study that at six months the preterm infant is more active in mother-infant interaction than fullterm infants, does not accord with the general view of persisting passivity and unresponsiveness. Crawford, in the only other study which observed mother-infant interaction at six months and in a naturalistic (home) setting, found that preterm infants vocalised less, looked at objects more, and were more irritable than fullterm infants. Dyadic measures were not used in Crawford's investigation, however, and those measures in this study indicate that at six months preterm infants were more interested in their mothers and less in their environment than fullterm infants. Goldberg, Brachfield and Di Vitto (1980) noted that at eight months preterm infants played less with their mothers than fullterm infants; taken together with these findings this suggests that, at six to eight months, preterm infants are not as actively involved in their environment as their fullterm counterparts.

In the model depicted in Figure A, mothers do not show the persistently high levels of activity toward their infant found by other investigators (Brown _et_ *al*, Field 1977; Crawford, Crnic *et al*). The initially high levels of interactive and affectionate behaviour drop, perhaps as a result of the unresponsiveness of their infants at two months; by six months although affectionate behaviour remains low, interactive levels are normal.

There appears then to be a broad process of over and under-compensation between members of the dyad. Initially passive infants seem to discourage their mothers' initial efforts to engage them; in turn it may be that low levels of maternal activity at three months lead to high compensatory interaction by the infants at six months. At each age, however, the balance is counter-productive for development a few months later. Levels of simultaneous interaction behaviour and mutual gaze at six months are negatively related to ten-month developmental quotients and levels of maternal interaction behaviour and maternal signalling alone at two months are positively related to four-month developmental quotients (see Chapter VI.)

Clearly, by six months the preterm dyads have not yet achieved optimal patterns of interaction, the fluctuations in maternal and infant activity combining to produce inappropriate levels for each age. Studies which have observed interactions throughout the first year find, in general, that differences between fullterm and preterm dyads diminish (Crawford, Brachfield, Goldberg and Sloman, 1980; but not Crnic *et al*.) Findings are to a considerable extent dependent on the observational situation, and upon the skills being acquired at the stage the infant has reached. Observations which span the first year, for example, cover the transition from the early primacy of developing social and interactive skills to the later predominance of orientation toward the environment and objects. Goldberg et al point to the difficulties in tapping the continuity of differences between preterm and fullterm dyads, noting the disappearance of differences in feeding interactions at four months, but the appearance at eight months of dramatic differences in the approach to floor play between the dyads.

Most follow-up studies of preterm infants which involve interaction observations have used laboratory settings and often structured situations (Crnic et al, Field, Brown et al, Goldberg et al). Some e.g. Di Vitto et al, and Brown et al used a specific activity such as feeding. In an attempt to avoid the formality and stress of a laboratory setting, the observations in this study were made in the home. Further, because the nature of infant feeding changes in the first six months from breast or bottle to solid food, and because it was felt that feeding situations in the early months were vulnerable to being affected by the presence of an observer, observations were concentrated on activities which encouraged the participation of the mother as a matter of course such as bathing and changing. These are activities which are carried out throughout the first year and both embody familarity of procedure and are hence able to reflect interactional changes within their structure.

In this way, it is hoped that naturalistic changes in the balance of the interaction of the dyads, not constrained by developmental differences in the infants, have been observed. These changes become more salient when discussed in the context of their relationship to Developmental Quotients.

(2) <u>Small-for-Dates Interaction Patterns</u>

The interaction process in the first six months developed rather differently for the SFD dyads from the preterm dyads in the study. Figure B illustrates the main trends for the SFD group.

At the two months the SFD infants were often drowsy, but paradoxically had high levels of signalling behaviour. SFD mothers at this stage interacted at normal levels, with the exception that they rarely smiled at their infants. So at two months these dyads had high levels of simultaneous interaction, but also low synchrony values contributed to by low Infant Interaction Ratios. At three months the infants' interactive levels were the same as fullterm infants, but they were more often drowsy and fussy. Their mothers had decreased their interactive levels, leading to low simultaneous interaction values and low synchrony levels.

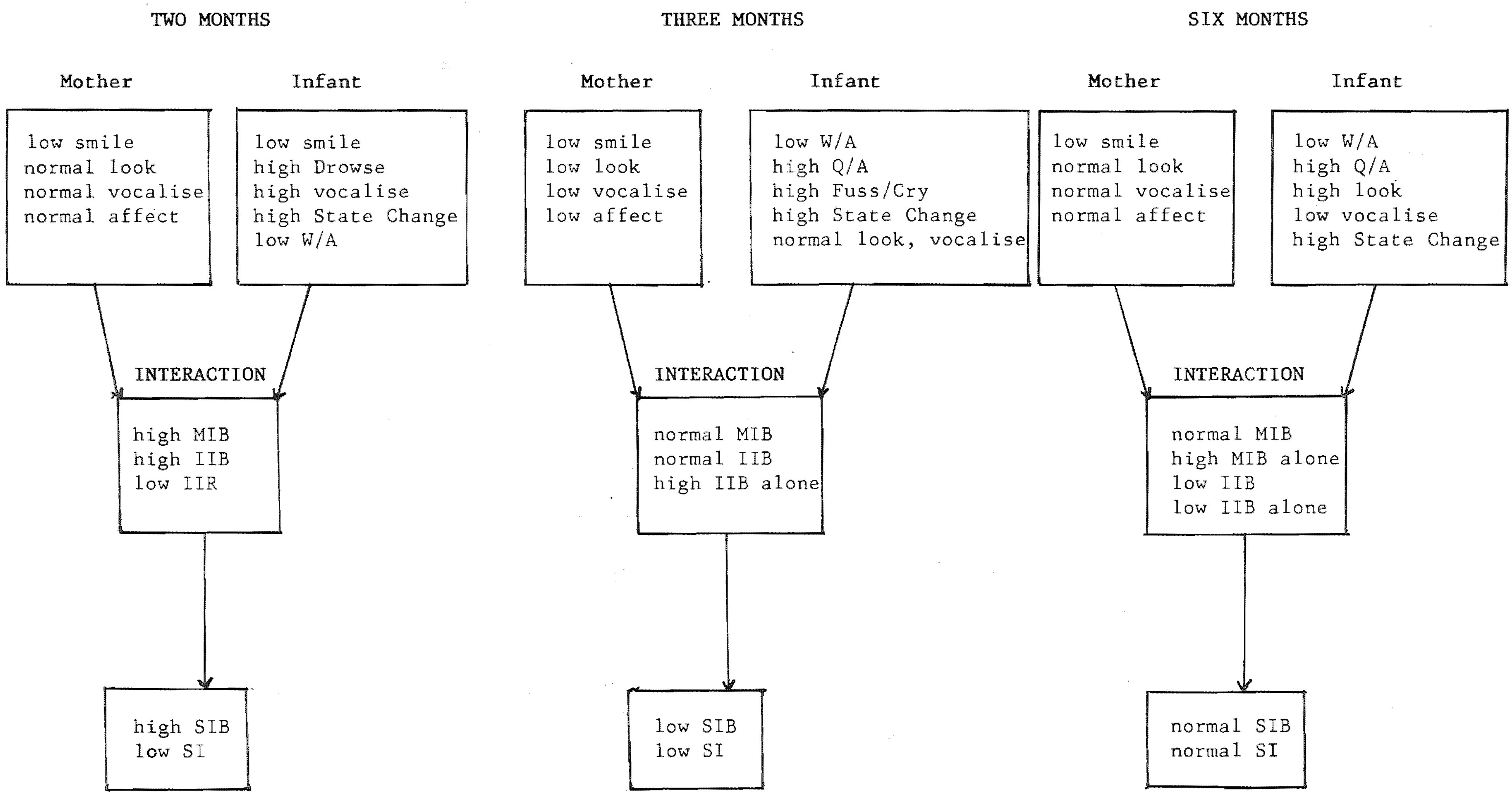


FIGURE B : PATTERNS OF INTERACTION FOR SMALL-FOR-DATES INFANTS AT TWO, THREE AND SIX MONTHS

At six months maternal interaction levels were normal though they tended to signal alone more often. Infant interaction levels were slightly low, and infants signalled alone less often, but the dyads' levels of simultaneous interaction and synchrony were the same as fullterm dyads.

Levels of interactive activity thus move in the opposite direction for SFD infants, when compared with preterm infants. At two months they show high rates of interactive behaviour, and move through normal levels at three months to comparatively low levels at six months. More significantly, this change is accompanied by persisting state organisation differences. At all three stages SFD infants have high rates of state change, low levels of W/A and high levels of Q/A.

The mothers in the SFD group seem to be more successful than their preterm counterparts in balancing the dyad so that it achieves optimal levels of interaction. Although the frequencies of maternal behaviour drop from two to three months, levels of maternal interaction reach normal levels and remain there from three months onward. However at six months SFD mothers appear to be compensating somewhat for decreased infant interactive levels in order to maintain levels of simultaneous interaction.

Thus although at six months SFD dyads appear to be functioning in a similar way to fullterm dyads, there are more important differences, principally in state variables, which persist. It is a characteristic of SFD children that although they perform adequately on assessment tests, their functioning in their environment is often impaired (e.g. Fitzhardinge _et al_). This study indicates an underlying instability of state organisation which endures in these infants longer than in preterm infants. Further, interaction variables for the SFD group show a higher rate of consistency than fullterm or preterm groups, both from two to three months, and from three to six months, which suggests a relative inflexibility in the SFD dyads particularly as "neutrally" interactive variables such as simultaenous interaction levels and mutual gaze show persisting consistency. This may indicate a more rapid rate of mutual adaptation than the other groups; on the other hand a lack of flexibility in the early months, in this case abetted by continuing state instability, might be counterproductive for optimal development.

CHAPTER VI

DEVELOPMENTAL ASSESSMENTS

Infant intelligence tests have been, like IQ tests for older children, widely used for research and assessment with little regard for their consistency, validity, or predictiveness (for a discussion of the ubiquitous misuse of IQ tests in New Zealand, particularly in the school setting, see Smith, 1982).

The concept of intelligence in infancy is confused. Early theorists, notably Burt, Jones, Miller and Moodie (1934) advocated the existence of an innate "g" factor which could be measured, and was not subject to change. Several studies have invalidated this claim (e.g. McCall, Hogarty and Hurlburt 1972; Lewis and McGurk 1972), finding few relationships between scores at different ages, and no consistency across measures, using both standardised tests such as the Bayley scales and the Gesell Developmental Schedules, and Piagetian-based sensorimotor intelligence scales.

One of the major reasons for assessing infant development is to be able to predict performance beyond infancy, and tests were developed often in response to specific needs such as screening of infants for adoption purposes or identifying and classifying mentally retarded children. Predictability from infancy using standardised tests has proven to be almost impossible, and has caused a reassessment of the nature of infant intelligence acknowledging both its plasticity and the powerful influence of environmental factors. The development of sensorimotor tests based on Piaget's theory of intelligence has been one of the consequences, but in general prediction based on developmental assessments alone, including sensorimotor tests, has not been successful. Nonetheless the need for prediction remains, especially for groups of infants who are potentially at risk for later developmental dysfunction, and attempts have been made to look for alternative or additive features of infancy which might enhance prediction to later performance. Measures such as social competence in infancy (Doll 1953), socioeconomic status of parents (Bakeman et al 1980), specific infant behaviours such as vocalising (Cameron, Livson, and Bayley 1967), infant personality assessments (Birns and Golden 1972), and measures of attention (Kopp and Vaughn 1982) have been investigated for improved powers of prediction. Roe and her colleagues (Roe 1978; Roe, McClure, and Roe 1982) have found that male infants' differential vocal responses to mothers and strangers at three months predicts performance on the Stanford-Binet Scale at three years, and verbal and abstract-symbolic cognitive skills at twelve years; the authors stress the specificity of the related measures, noting no correlation with non-verbal skills from early vocal skills. Approaches to prediction utilising such specificity show considerable promise.

Standardised infant tests, however, are still in wide use in research both as measures of current performance and as one factor, in combination with other variables, for prediction of later performance. The Bayley Mental Development Index (MDI) has been found by Siegel (1981) to be able at four months to detect infants at risk for developmental delay at two years; prediction was improved when the MDI was combined with a measure of home stimulation. Honzik (1965) used the Bayley scales at eight months to differentiate infants suspected at birth of brain impairment, though experienced infant assessors were not able to do so in a clinical assessment. Careful use of infant tests, then, in combination with other assessments and with regard for their limitations, continues to be a major research tool in infancy.

It was decided, in this study, to use the Bayley MDI scale to assess current performance of infants at four and ten months. The preterm group was tested at corrected gestational age. The Bayley scales originated in 1933, developed to test children in the Berkeley Growth Study. They were revised in 1969; the MDI is described by Bayley as designed to "assess sensory-perceptual acuities, discriminations, and the ability to respond to these; the early acquisition of 'object constancy', memory, learning, and problem-solving ability;

vocalisations and the beginnings of verbal communication" (Bayley 1969).

The scale was administered by a trained psychologist who was otherwise unconnected with the study, and was naive to the infants' birth status.

I FOUR-MONTH BAYLEY MDI ASSESSMENT

(1) Results

(a) Group Scores The group means were as follows:

Fullterm: $\overline{X}$ 110.0, S.D. 11.7; range 97 - 135

Preterm: $\overline{X}$ 103.3, S.D. 10.2; range 84 - 117

SFD: $\overline{X}$ 103.0, S.D. 6.3; range 94 - 111

The preterm and SFD groups were significantly lower than the fullterm group (p = .1, two-tailed t-test). Brown *et al* found that when preterm infants were compared with fullterm infants at corrected ages on twelve-month Bayley MDI scores, there were no differences; however Crnic,Ragozin, *et al* found, as this study has, that preterm infants scored significantly lower than fullterms at four months on the Bayley MDI. Crnic *et al* also found a significant difference between these groups at twelve months, and like this study, had only healthy preterm infants in the group. Beckwith *et al*, using only preterm subjects, found that preterm infants had average scores at four months on the Gesell scales, but these were not compared with a fullterm control group.

Although several long-term assessments of the intellectual development of SFD infants have been carried out, few report on intellectual assessment at less than twelve months. Low et al found that at this age SFD infants scored lower than fullterm infants on Bayley mental and motor scales. Zeskind et al also noted, in a study of small-for-dates infants from low socioeconomic status families, that the SFD infants scored lower than the normal infants on the Bayley MDI at three months, independent of the environment.

There was also a significant sex difference in scores for the total sample. The mean for females was 101.5 (S.D 11.2), and for males 107.6 (S.D. 9.9) ($p = .1$ two-tailed t-test). Few studies which include developmental assessments include reports of analysis of sex differences. Of those who do, Beckwith et al found no differences between males and females on four-month performance on the Gesell scale; however by nine and twenty-four months there was a significant difference in favour of girls in the English-speaking sample. Within the Spanish-speaking sample, at nine months the difference was significantly in favour of boys; furthermore Roe, Drivas, Karagellis and Roe (1981) found that Greek male infants who were home-reared performed better than equivalent females, whereas no such difference existed for institution-reared infants. Roe points out the parental preference for boys in Greece and contrasts this sex difference in cognitive performance with findings in U.S.A. where the few differences that are found are in favour of females.

(b) <u>Relationships Among Four-month MDI Scores and Mother-Infant Interactions</u>. Table 30 shows the Pearson Product-Moment correlations between four-month MDI scores and variables from the two-month and three-month interaction observations.

In the fullterm group, infant frequencies of looking and smiling, maternal frequencies of smiling and vocalising, the levels of infant interaction to maternal look and vocalise, the Synchrony Index and simultaneous interaction behaviour excluding fussing, were all positively correlated with MDI scores at two months. Infant levels of Q/A, state change and fuss at two months were negatively correlated with four-month MDI scores.

The only infant frequency variables for the preterm group to be significantly related to four-month MDI were the state variables of W/A and Q/A. At both two and three months, level of W/A was positively related to the MDI. Maternal frequency levels of look and affectionate behaviours at two months were negatively related to MDI, while maternal smile at three months was positively related for this group. MIB to W/A and MIB alone at two months were negatively correlated with

TABLE 30

CORRELATION COEFFICIENTS AMONG FOUR MONTH MDI SCORES AND MOTHER-INFANT INTERACTION VARIABLES AT TWO AND THREE MONTHS

INFANT FREQUENCIES		FT	PT	SFD
W/A +	2mo	.5744	.5205*	.2730
	3mo	-.4994	.5717**	-.4345
Q/A +	2mo	-.5843*	-.3486	-.1958
	3mo	.4653	-.5114*	.2486
Dr	2mo	-.2259	.3489	-.1056
	3mo	.4387	-.1977	.3563
F/c	2mo	-.1724	-.3680	-.1524
	3mo	.1892	-.3379	.0352
1/m	2mo	.5787*	.1779	.3250
	3mo	.1382	-.0067	-.0391
voc	2mo	.2703	.2069	-.3631
	3mo	-.5234	-.2425	-.2429
Smile	2mo	.6477*	.3887	.5970
	3mo	.0275	.4090	.6716*
State Change	2mo	-.5869*	-.3943	.0644
	3mo	.3839	-.1989	-.2635
fuss	2mo	-.6800*	.2968	.1701
	3mo	.1002	.1166	.1889

MATERNAL FREQUENCIES		FT	PT	SFD
Smile	2mo	.7984***	-.1995	-
	3mo	-.2898	.5003*	-.0635
Look +	2mo	.5794	-.5074*	.5500
	3mo	.2029	.1612	-.1435
voc +	2mo	.6174*	-.2111	.3477
	3mo	.1424	-.0227	.1286
Affect +	2mo	-.3709	-.6546***	.7939**
	3mo	.1128	.0060	.6422*

INTERACTION VARIABLES		FT	PT	SFD
MIB to W/A	2mo	.5364	-.5788**	.3293
	3mo	.2321	.0744	.2584
MIB to Q/A	2mo	.0812	-.2663	.4104
	3mo	.5064	.0394	.1774
W/A-Q/A diff +	2mo	.3066	.6288**	-.2684
	3mo	.0936	.5171*	.2960
MIB to 1/m voc	2mo	.0629	-.4179	.2713
	3mo	.5023	.3185	.0282
MIB m-modal	2mo	-.1776	.0455	.4967
	3mo	.2458	.2989	.2522
IIB to 1/b voc	2mo	.5987*	.2400	-.0016
	3mo	.2302	.0032	-.1037
IIB m-modal	2mo	.1072	.4379	.2306
	3mo	.2459	.1050	.5812
SIB	2mo	.3843	.0073	.4354
	3mo	.1446	.1708	-.1319
SIB excl fuss	2mo	.6529*	-.0448	.3624
	3mo	.1934	.1673	.0076
SI	2mo	.6200*	.1343	.3961
	3mo	.0463	.3173	.4052
MIB alone	2mo	-.0717	-.5211*	.1525
	3mo	.0446	-.2288	-.0751
IIB alone	2mo	-.0257	.2676	-.4015
	3mo	-.5159	-.2174	-.2616
IIR	2mo	.3590	-.2823	.2713
	3mo	.5404	.2404	.3268
MIR	2mo	.4231	.0792	.2124
	3mo	.5379	.2635	.3598
IIB to voc	2mo	.5448	.2818	.0608
	3mo	.0562	.1202	-.0857
MIB to fuss	2mo	.1057	-.7249***	.2154
	3mo	.1948	-.0464	.3657
Mutual gaze	2mo	.6576*	.0404	.5153
	3mo	.0884	.1361	.0454

* p=.1
**p=.05
***p=.02
+ Indicates that significant differences exist between group correlations.

MDI but maternal differential response to W/A and Q/A at two and three months was positively correlated.

The SFD group showed only two variables to be related to four-month MDI. They were infant smile at three months, and maternal affectionate behaviour at two and three months.

(2) <u>Discussion</u>

(a) <u>Fullterm Group</u>. It is notable in the fullterm group that the significantly related variables were all in two-month interactions, which suggests the relative importance for this group of the early interaction style. Overall levels of signalling behaviour of both infant and mother contributed to the relationships between two-month mutual gaze, SIB excluding fuss and the S.I. and four-month MDI. The relationship of maternal look to MDI became significant when fullterm and SFD groups are combined, so that for fullterm dyads maternal looking, smiling and vocalising, along with infant looking and smiling, appeared to be important for development at this age. The negative relationship between infant fuss and MDI is similar to a finding by Beckwith <u>et al</u> that infant irritability at one month was negatively correlated with four-month Gesell scores, though their study was with only preterm infants, and this relationship was not found for the preterm group in this study.

One study which can be compared with the present findings is that by Lewis and Coates (1980) who looked at measures of maternal-infant interaction at four months, and compared them with four-month Bayley MDI scores. They found no or negative relationships between levels of maternal stimulation and MDI, but positive relationships between MDI and the contingency variables of maternal responsivity and maternal level of interaction. The results for levels of maternal stimulation are not supported by the findings in this study for two-month interactions; in particular, distal behaviours such as smile, look and vocalise which were negatively correlated with MDI in Lewis and Coates" study were positively correlated here. However these variables at three months were not related to four-month MDI, and this is a closer comparison with Lewis and Coates' study than the two-month variables. Furthermore, although small sample size precludes significance, the variable in this study most closely approximating Lewis and Coates' maternal responsivity, i.e. maternal interaction behaviour to infant look and vocalise at three months was moderately correlated with MDI. Also MIR, which is the same variable as Lewis and Coates' maternal level of interaction, was significantly related for the total sample to four-month MDI ($r = .4714$, $p = .01$ two-tailed test). It appears, then, that for fullterm infants maternal stimulation levels had some importance at two months, but that maternal contingency or interactive variables became increasingly significant.

The state variables in this study, however, indicate that the salience of maternal responsivity was mediated by infant state. Although the correlations were not all significant there was a strong trend for the importance of levels of W/A and Q/A, and maternal responsivity to these, to change positions from two to three months. There is a significant difference between the two-month and three-month correlations for W/A levels ($z = 2.6$ $p = .01$) and for Q/A levels ($z = 2.3457$ $p = .01$). For the infant it appeared to be an advantage to be more often in W/A and less often in Q/A at two months, but at three months to spend more time in Q/A and less time in W/A. Similarly, maternal responsivity to W/A at two months, and to Q/A at three months, tended to be related to four-month MDI. Results from the interaction observations (Chapter IV) indicated that as a group, fullterm infants increased their levels of W/A and Q/A slightly from two to three months, but fullterm mothers increased their responsivity to W/A and slightly decreased their responsivity to Q/A.

Table 30 also shows that fullterm infant variables contributed, at two months, to their four-month MDI performance. Their levels of smiling and looking were positively related, and fussing was negatively related; so was their responsivity to maternal looking and vocalising. Their two-month rate of state change, too, was negatively related to the four-month MDI suggesting the influence of early behaviour organisation on development.

(b) <u>Preterm Group</u> There was an unclear pattern of relationships for the preterm group. Several two-month maternally-based variables were significantly negatively related to four-month MDI. They were maternal levels of looking and affectionate behaviours, maternal responsivity to W/A and fuss, and maternal signalling alone. Correlations do not indicate directions of effect, and infants who perform cognitively less well may have induced high levels of maternal stimulation; conversely maternal overstimulation may have adversely affected cognitive development. Clearly, however, the two-month mother-infant interaction for preterm infants had a different relationship with four-month development from the fullterm group, where levels of maternal activity tended to be positively related. There were in fact significant differences between the correlations for preterm and fullterm groups for two-month maternal look ($z = 2.5217$ $p = .01$), two-month maternal vocalising ($z = 1.934$ $p = .05$) and MIB to W/A ($z = 2.6$ $p = .01$).

The only preterm infant variables related to MDI were state variables. W/A state was positively related at two and three months; Q/A at two months became significantly negatively related when combined with fullterm values and stood negatively significant at three months. Thus W/A state itself continued to be important to development for preterm infants at three months though this was not paralleled, as it was for fullterm infants, by the importance of maternal responsivity to W/A at two or three months; the differential effects on the two groups of this variable is striking. This suggests the possibility that the preterm mothers' stimulation was overwhelming for the infant at two months whereas for the fullterm infants it was beneficial. Further support from this suggestion comes from the nonsignificant but negative correlation between maternal responsivity to infant look and vocalise at two months and four months MDI but more importantly from the range of maternal stimulation variables which are significantly negatively correlated with MDI scores. It seems that maternal attempts at stimulation could become overwhelming for the two-month (corrected age) preterm infant, and furthermore this inability to cope did not appear to diminish by three months' corrected age, as the only maternal variable to become positively related at three months to MDI was the passive one of maternal smile.

The relationships between preterm infant W/A and Q/A and four-month MDI indicate that they were the same at two months as at three months; however these are corrected ages, so that in fact in these respects the preterm infants' state relationships with MDI were two months behind those of the fullterm group.

Intriguingly, for the preterm group but not the others the extent to which the mothers responded differentially to W/A and Q/A was significantly correlated with four-month MDI at both two and three months. The direction of the difference did not appear to matter, though there was a strong tendency for females to receive more stimulation while in Q/A (75% of females in the total sample); the trend was not quite so strong for boys to be stimulated in W/A (65% of males in the total sample). Again, it is only possible to speculate about the direction of the relationship between the MDI and the differential responding. It may have been that infants who were developing optimally were also very clearly in one state or another, thus facilitating differential levels of responsiveness, though it would be hard to explain why this was not the case for fullterm infants. Alternatively, maternal ability to "read" infant states and to respond differentially might have contributed to the infant's development by, perhaps, stabilising rates of state change or facilitating state organisation in the infant. Clearly what was important was the differentiation of states for these infants, not high levels of interactive behaviour to one or the other as was the case for the fullterm infants.

(c) Small-for-Dates Group No clear picture emerged for the SFD group. There were no state variables, nor any interaction variables, related to four-month MDI. However infant smile at two and three months, and maternal affectionate behaviours at two and three months, were positively correlated to the MDI. Maternal affection was in contrast to its opposite relationship with MDI for the preterm group; the difference between the correlations was highly significant (z = 3.669 p = .001). It is possible that the affectionate behaviours of touching, rubbing, rocking and hugging might have had a calming and alerting effect on the somewhat confused behaviour of the SFD infant, whereas it exacerbated the unresponsive tendencies of the preterm infant. However there is no other evidence to support this speculation apart from noting that infant smiling usually occurs when the infant is calm and attentive, and infant smile was the only other variable which showed a relationship with MDI for the SFD group. Overall the development of SFD infants at four months in relation to mother-infant interaction was quite different from either fullterm or preterm infants; particularly striking is that lack of relationships between the two areas of development.

It is also clear that any possible conclusions reached from these data apply only to the early months; the plasticity of the mother-infant relationship and of infant development at this stage is more impressive than its constancy, and no generalisation can be attempted beyond the first four months.

II TEN MONTH BAYLEY MDI ASSESSMENTS

(1) Results

(a) Group Scores The group means were as follows:

Fullterm: $\bar{X}$ 117.9, S.D. 19.8; Range 82 - 148

Preterm: $\bar{X}$ 101.7; S.D. 16.8; Range 81 - 138

SFD: $\bar{X}$ 101.8; S.D. 17.6; Range 76 - 130

As with the four-month scores, the preterm and SFD groups were significantly lower than the fullterm group ($p = .1$, two-tailed t-test). There was also a significant difference between scores for twins and singletons in the preterm group. For the singletons $\bar{X} = 93.8$, S.D. 7.7; for for the twins $\bar{X} = 107.6$, S.D. 19.7 ($t = 1.612$ $p = .2$ two-tailed t-test).

No significant sex differences were found for the ten-month scores although the positions had reversed in comparison with the four-month scores. The mean for females was 110.6, S.D. 20.3; for males 103.4, S.D. 17.5.

(b) Relationships Between Four-month and Ten-month MDI Scores For the total sample there was a significant positive correlation between MDI scores at four and ten months ($r = .3546$ $p = .05$ $n = 34$). Analysis of separate group scores, however, shows that there was no consistency for the preterm group. Fullterm correlation was $r = .5024$; preterm $r = -.1444$; SFD $r = .4270$. For the fullterm and SFD groups combined, $r = .5792$ ($p = .01$).

(c) Relationships Between Ten-Month MDI Scores and Two and Three Month Interaction Variables In the previous section the relationships between early interaction variables and four-month MDI performance was examined. It is important to consider, too, the ways in which early interactions were related to development later in infancy. Table 31 shows the pattern of correlations. In overall terms, there were more significant correlations with ten-month development (17.2%) than with four-month development (13.3%). However, the patterns were different for each group.

(i) Fullterm Group 18.3% of the two and three-month variables were related to ten-month development. Infant fuss/cry, maternal differentiation of states, and maternal signalling alone were all positively related; infant vocalising, maternal smile, infant response to maternal vocalising, and infant multi-modal signalling were negatively related.

(ii) Preterm Group Infant vocalising at three months and maternal differentiation of states at three months were positively related to ten-month MDI in this group, and maternal affectionate behaviour, maternal multi-modal signals, maternal signals to Q/A and to fuss were negatively correlated with MDI scores.

(iii) Small-for-Dates Group Compared with just two correlations between early variables and four-month MDI scores, the SFD group showed fourteen significant relationships between early interaction and ten-month MDI performance; furthermore, they were all negative. W/A at

TABLE 31

CORRELATIONS AMONG TEN MONTH MDI SCORES AND TWO AND THREE MONTH INTERACTION VARIABLES

INFANT FREQUENCIES		FT	PT	SFD	MATERNAL FREQUENCIES		FT	PT	SFD	INTERACTIVE VARIABLES		FT	PT	SFD
W/A	2mo	.0607	.1780	-.7991**	Smile	2mo	.1628	.4140	-	MIB to	2mo	.0038	.1791	.1977
	3mo	-.4648	.1209	-.8829**		3mo	-.6343**	.1936	.2144	W/A	3mo	.1876	-.1085	-.0064
Q/A	2mo	-.4038	-.3069	-.3906	look	2mo	-.0419	.3594	.0679	+MIB to	2mo	.4836	-.4708*	-.1412
	3mo	.4659	-.0374	.4988		3mo	-.2525	.0721	.1515	Q/A	3mo	.1775	-.0063	-.2324
Dr	2mo	-.4215	.0124	.5753	voc	2mo	.4560	.2794	-.0114	W/A-Q/A	2mo	.6413*	.4749*	.0289
	3mo	.1468	.2082	.5060		3mo	.1253	-.2145	-.0013	diff	3mo	.3237	.3485	-.4419
F/c	2mo	.6349*	.1902	.5578	affect	+2mo	-.5326	.2799	.5912	MIB to	2mo	-.4232	.1344	.2178
	3mo	.1342	-.0255	.0166		3mo	-.3226	-.5149*	.4418	l/m voc	3mo	.0504	-.2642	-.0658
l/m	2mo	-.1362	.0221	-.6118						MIB m-	2mo	.1215	.2956	.2710
	3mo	-.3193	.1224	-.7112**						modal	3mo	-.1543	-.5182*	.2414
voc	2mo	-.5845*	-.2317	-.7068**						IIB to	2mo	-.2821	-.1188	-.8359***
	+3mo	-.6385**	.5150*	-.6334*						l/b voc	3mo	-.5819	.2265	-.7407**
fuss	+2mo	-.5830*	-.1113	.4308						IIB m-	2mo	-.6620**	-.1397	-.4554
	3mo	-.1061	-.3046	-.1877						modal	3mo	-.5875*	.2695	-.4372
Smile	2mo	-.0859	-.3448	-.2720						SIB	2mo	-.3715	-.1553	-.3039
	3mo	-.5470	.2464	.1052							3mo	-.4786	.0525	-.6466*
State	2mo	-.1935	-.1588	.4614						SIB excl	2mo	-.1131	-.1430	-.6031
Change	3mo	.2216	-.2340	.4455						fuss	3mo	-.3492	.1670	-.6353*
										SI	2mo	-.0768	-.1955	-.6694*
											3mo	-.3435	.0592	-.6272*
										IIB	2mo	-.2753	.0951	-.3550
										alone	3mo	-.2594	.3546	.3049
										MIB	2mo	.7435**	.2948	.5324
										alone	3mo	.6887**	-.2268	.3809
										IIR	2mo	.0918	-.0336	.0969
											3mo	.0173	-.1225	.0615
										MIR	2mo	.0260	-.2192	-.6696*
											3mo	-.2812	.2054	-.3574
										IIB to	2mo	-.3805	-.1560	-.7675**
										+voc	3mo	-.5852*	.3240	-.6715*
										MIB to	2mo	-.4013	.0934	.0069
										fuss	3mo	.0150	-.5802**	.2506
										Mutual	2mo	.0107	.0588	.2534
										gaze	3mo	-.3832	.0132	.5780

*p=.1
**p=.05
***p=.02
+ Indicates that significant differences exist between correlations, see text

two and three months, infant look at three months, infant vocalise at two and three months, infant response to maternal look and vocalise at two and three months, Simultaneous Interaction Behaviour (SIB) at three months, SIB excluding fuss at three months, Synchrony Index at two and three months, maternal interaction ratio (MIR) at two months, and infant interaction with maternal vocalising at two and three months all showed negative correlations with ten-month mental development.

(d) Relationships Between Ten-month MDI Scores and Six-month Interaction Variables Table 32 displays the correlations between six-month interaction variables and MDI scores. Overall, 25.4% of the variables show significant relationships.

(i) Fullterm Group Maternal levels of vocalising, maternal interaction with infant W/A, maternal interaction with infant vocalising and with infant fuss, maternal signalling alone, and infant interaction ratio were psotively related to MDI scores; infant vocalising and infant signalling alone were negatively correlated with ten-month development.

(ii) Preterm Group Infant vocalising in this group was positively related to MDI performance. Infant smile, maternal interaction with infant play, and maternal quiescence also showed a positive relationship. However maternal look, maternal interaction with infant fuss, mother response, simultaneous interaction including and excluding fuss, and mutual gaze were all negatively correlated with ten-month development. Table 33 shows

TABLE 32

CORRELATIONS AMONG TEN MONTH MDI SCORES AND SIX MONTH MOTHER-INFANT INTERACTION VARIABLES

INFANT VARIABLES	N=10 FT	N=14 PT	N=9 SFD	MATERNAL VARIABLES	FT	PT	SFD	INTERACTIVE VARIABLES	FT	PT	SFD
W/A	-.3901	-.0676	.0504	+Look	.4382	-.4828*	.0165	MIB to W/A	.7640***	-.6299***	-.1159
Q/A	.3602	.0661	-.1772	+Voc	.8496****	-.3270	-.0464	MIB to Q/A	.5414	-.2917	.3840
Look/M	.2966	-.1863	-.5296	Smile	.2503	.3865	-.2507	MIB to Look	-.3980	-.5268**	-.1926
Voc	-.7226***	.6649****	-.1336	Affect	-.0473	-.3907	.4374	MIB to Voc	.7259***	.1235	.0424
1/Obs	-.0686	.2540	-.2816	Play	.1159	.2003	.1495	MIB to Play	.2133	.5340**	.3936
1/Obj	-.1514	.2240	-.2657					W/A-Q/A Diff	-.4004	.1084	-.5772
Play	-.3016	.3334	.5721					MIB to Fuss	.6143*	-.4692*	-.1600
Smile	.0767	.5968**	-.1653					Mother R	.0167	-.6047**	-.5939*
Fuss	.0017	-.2193	.3038					Mother Q	-.5479	.4851*	.0189
State Change	.2916	-.2936	-.0405					IIB to Voc	.1702	.0112	-.4190
								IIB to Look	.3299	.1487	-.6789*
Q/A 1/m 1/Obs diff	.3132	-.0776	-.8467****					Infant R	.4142	.4269	-.3072
								Infant Q	-.0623	-.6008**	-.2179
								SIB	.3964	-.6936****	-.4106
								SIB Excl Fuss	.5273	-.6468***	-.7000**
								SI	.2342	-.4990*	-.7259**
								IIB alone	-.7653***	.0213	.0396
								MIB alone	.7427***	-.2335	.4107
								IIR	.7687****	.2422	-.2125
								MIR	-.3172	-.0686	-.6102*
								Mutual Gaze	.3629	-.5976**	-.6637*
								Both Q	.0947	.4336	.0853

*p=.1
**p=.05
***p=.02
****p=.01
+ Indicates that significant differences between correlations exist, see text.

TABLE 33
SIGNIFICANT DIFFERENCES BETWEEN CORRELATIONS FOR SIX MONTH INTERACTION VARIABLES; PRETERM AND FULLTERM GROUPS

VARIABLE	FULLTERM COEFFICIENT	PRETERM COEFFICIENT	z	p
Infant vocalising	-.7226	.6649	3.537	.001
Maternal look	.4382	-.4828	2.054	.05
Maternal vocalise	.8496	-.3270	3.2747	.001
MIB to W/A	.7640	-.6299	3.602	.001
MIB to infant look	.3980	-.5268	2.079	.05
MIB to infant fuss	.6143	-.4692	2.524	.01
Mother Quiescent	-.5479	.4851	2.368	.01
SIB	.3964	-.6936	2.631	.01
SIB excl fuss	.5273	-.6468	2.480	.01
Mutual gaze	.3629	-.5976	2.207	.05

variables with with significant differences between correlations for the fullterm and preterm groups.

(iii) Small-for-Dates Groups . All significant relationships for this group were negative, as they were for the two and three month variables and ten-month MDI. Mother response (a directional exchange initiated by the infant), infant interaction with maternal look, SIB excuding fuss, S.I., maternal interaction ratio, and mutual gaze were all negatively related to ten-month development. Also, the extent to which the infant differentiated mother from observer in Q/A had a negative correlation with ten-month development. Table 34 shows the variables with significantly different correlations for the fullterm and SFD groups, and Table 35 shows the same differences for the preterm and SFD groups.

(2) Discussion

(a) Group Scores This study notes the continuing lag in development for preterm infants, in agreement with the findings of Crnic et al. The similar finding for SFD infants is also in accord with other investigators, notably Low et al and Zeskind et al. It is of interest to note that the score ranges have increased compared with the four-month assessments; this might reflect the differential effects by ten months of the socioeconomic status of the families, and correlations between SES ratings and ten-month MDI scores indicate support for this suggestion for the fullterm and preterm but not the SFD group. (Fullterm r = -.5710 p = .1; preterm r = -.5471 p = .05; SFD r = .0986). The implications of the lack of

TABLE 34
SIGNIFICANT DIFFERENCES BETWEEN CORRELATIONS FOR SIX MONTH VARIABLES AND TEN MONTH MDI SCORES; FULLTERM AND SFD GROUPS

VARIABLE	FULLTERM COEFFICIENT	SFD COEFFICIENT	Z	p
Infant play	-.3016	.5721	1.73	.05
Q/A 1/m 1/obs diff	.3132	-.8467	2.8	.01
Maternal vocalise	.8496	-.0464	2.256	.05
IIB to look	.3299	-.6789	2.15	.05
SIB excl fuss	.5273	-.7000	2.615	.01
Mutual gaze	.3629	-.6637	2.007	.05
SI	.2342	-.7259	2.09	.05
IIR	.7687	-.2125	2.211	.05

TABLE 35
SIGNIFICANT DIFFERENCES BETWEEN CORRELATIONS FOR SIX MONTH INTERACTION VARIABLES AND TEN MONTH MDI SCORES: PRETERM AND SFD GROUPS

VARIABLE	PRETERM COEFFICIENT	SFD COEFFICIENT	Z	p
Infant vocalise	.6649	-.1336	1.82	.05
Infant smile	.5968	-.1653	1.69	.05
Q/A 1/obs 1/m diff	-.0076	-.8467	2.6	.01
Maternal affect	-.3907	.4374	1.74	.05
IIB to look	.1487	-.6789	1.92	.05

relationship for the SFD group will be considered later.

The somewhat surprising direction of the difference in scores for twins and singletons becomes coherent when the variables which show significant twin-singleton differences are considered. Three, in which twins had lower levels than singletons (S.I., SIB, and SIB excluding fuss) were negatively related to ten-month MDI scores in the preterm group; one (MIB to play) in which the twin dyads had higher levels than the singletons, had a positive relationship with ten-month development. It seems that twins, who had to share their mother's attention with a sibling, had less overall interaction and perhaps directed their attention toward objects and play, which appears to have been more optimal for development at six months. They also benefited from maternal encouragement to play, which mothers of twins might be more likely to do than singleton mothers.

The lack of sex differences in MDI scores parallels an overall lack of sex differences in observed variables at six months. It is not obvious why sex differences should be evident at two and three, but not six months as they might be expected to increase rather than decrease with time if they are environmentally mediated. The data considered in this study do not permit a ready explanation.

(b) <u>Relationships Between Four-month and Ten-month MDI Scores</u> The finding of a significant correlation between four and ten-month MDI scores concurs in general with the findings of Siegel (1982) who reported that four-month MDI scores predicted eight, twelve, eighteen and 24-month scores. Siegel's subjects were both preterm and fullterm infants, and correlations for the two groups are not reported so it is not possible to compare the findings here for preterm infants. The fullterm group showed significantly positive relationships between both SES level and four-month MDI performance, and ten-month MDI scores which suggest a steady rate of development and influence upon development at least through the first six months. The preterm group however had a positive correlation between SES and ten-month development but no relationship between four and ten-month MDI scores, suggesting an uneven rate of development with a cumulative effect of SES becoming manifest by ten months. The relationships for the SFD group, moreover, were the inverse of those for the preterm group; four and ten-month MDI scores were positively correlated whereas SES had no apparent influence by ten months, indicating early stability of performance but no relationship with SES. The implications of these patterns will be discussed later.

(c) <u>Relationships Between Ten-month MDI Scores and Two and Three month Interaction Variables</u> In this part of the discussion, Table 31 will be considered in comparison with Table 30, which shows the relationships between the same interaction variables and four-month MDI scores.

(i) Fullterm Group Several interaction variables e.g. infant fuss, vocalise, infant multi-modal signalling, infant interaction with maternal vocalising, and maternal smile were negatively related to ten-month MDI performance. In contrast, other interaction variables e.g. infant look, smile, SIB, S.I., and mutual gaze were positively related to four-month MDI. This apparent contradiction is puzzling especially as there is a positive correlation between four-month and ten-month MDI scores. But there is a predominance, in Table 30, of specifically dyadic measures such as SIB and mutual gaze, which relate positively to four-month development whereas the measures negatively related to ten-month development tended to be infant-based; infant fuss was the only variable to be consistently related to development at both ages, and maternal smile showed a positive correlation with four-month MDI and a negative relationship with ten-month MDI.

It is probable that variables combine in different ways to affect development at different stages. These findings demonstrate the danger of assuming either that development is linear or that factors beneficial at one stage will necessarily be so at a later stage.

(ii) Preterm Group The kinds of variables related to four and ten-month development were more similar for this group than for the fullterm group. At both stages there was a predominance of maternally-based variables which had a negative relationship with intellectual functioning; it may be that preterm infants who performed at low levels induced efforts at stimulation from their mothers; or maternal stimulation in the early months might have had an adverse effect on intellectual performance. The lack of correlation between four and ten-month MDI scores for this group would support the latter explanation, and is in general accord with Field's (1979) suggestion that preterm mothers' tendency to overstimulate their infants causes the infants to take avoiding action such as gaze aversion. It is important, too, to note that the one variable which had a positive relationship with both stages of development was the extent to which mothers differentiated W/A and Q/A states in their interactions with their infants. It was suggested earlier that state clarity might be high in infants who were developing optimally, alternatively the consistent distinction of states by the mothers might have helped the infants' state organisation and thus facilitated development. The fact that this variable was significant for ten but not four month development in fullterm dyads, taken with the apparent consistency of development in fullterm but not preterm infants, suggests that the mothers' ability to read infant states is likely to be more important, since infant clarity of states associated with optimal development would indicate that there should be an association with four month development in the fullterm group as well. It is likely, however, that there is an interaction between both factors.

(iii) Small-For-Dates Group Despite the moderately positive correlation between four-month and ten-month MDI scores for these infants, there were no variables related to both stages of development. The two which were positively related for four-month MDI performance were passive (infant smile, maternal affection); although there were no positive relationships with ten-month MDI performance those nearest to significance were infant drowse, maternal affection and MIB alone, two of which reflect infant inaction and again the potentially calming actions of mothers. In contrast all five infant-based variables which were negatively related to ten-month development reflect infant action (W/A, look, vocalise, IIB to l/b voc and IIB to voc), and the four others indicate high interaction levels (SIB, SIB excluding fuss, S.I., and MIR). It seems, then, that infant passivity and inaction, and maternal soothing behaviour, were related to optimal development in these infants, who are sometimes characterised as jittery in clinical descriptions (e.g. Fancourt 1982).

(d) Relationships Between Ten-Month MDI Scores and Six-Month Interaction Variables The results of these comparisons will be discussed first as they stand, then in comparison with the two and three-month variables.

(i) Fullterm Group The large proportion of maternally based variables which are positively related to ten-month development indicate a pattern of maternal attentiveness and stimulation for infants who had high ten-month MDI scores. The negative relationships for infant vocalising and infant signalling alone (IIB alone) suggest the corollary, that infant action without maternal response was associated with lower MDI scores, and the tendency for maternal quiescence to be negatively related to MDI supports this.

The two and three-month variables' pattern of relationship with ten-month MDI also indicated that infant action (vocalising, smiling, multi-modal responses, fussing), was related to less optimal performance on the MDI whereas few maternally based variables at this stage were related. However MBI alone was positively related at two, three and six months to ten-month MDI. This was a measure of maternal distal stimulation behaviour (looking, smiling, vocalising) in the absence of infant signals. It is impossible to determine whether infant inaction, maternal stimulation, or both were most salient. Infant vocalising was also related, although negatively, at all three ages; this too cannot be explained from the observations made.

(ii) <u>Preterm Group</u> Whereas only 10% of two and three-month variables were significantly correlated with ten-month MDI in this group, 36.8% of the six-month variables were, indicating the comparative sensitivity of preterm infants to stimulation later rather than earlier in the first six months. Furthermore although several were strictly dyadic variables (e.g. SIB), the majority were maternally based. The overall pattern is one of maternal stimulation being adversely related to developmental quotients at ten months with maternal quiescence being positively related. The infant contribution is indicated by the positive correlations of infant vocalising and smiling, and the negative relationship of infant quiescence; hence infant action appeared to be a characteristic of high-scoring infants.

This six-month pattern appears to be an expansion of that for the earlier interaction variables. However the most impressive feature of the six-month relationships is demonstrated in Table 33, where ten variables were found to have significantly contradictory relationships with ten-month development for the preterm and fullterm group. The predominance of maternally-based variables again emphasises the salience of stimulation and responsivity; the differential relationship of these to development strongly suggests that preterm and fullterm dyads function very differently in interaction at six months.

Siegel (1982), in a two-year study of preterm and fullterm infants, noted that prediction of developmental outcome at two years from the four-month MDI was enhanced by including a measure of maternal responsiveness. This factor was part of a scale assessed by parental interview, and it is suggested that the observations in this study provide a more detailed measure of interaction. Siegel's results are not differentiated for fullterm and preterm infants, nor are the assessments made at the same stages, so an accurate comparison is not possible. However it is worth noting that eight-month MDI scores in the Siegel study had enhanced predictiveness when a factor measuring provision of play materials was included; this supports the suggestion here for the preterm group that attention to objects might be most optimal at six months.

(iii) Small-For-Dates Group The pattern of negative correlations for the group is one which strongly indicates that low levels of interaction characterised the infants who scored highest at ten months; and as well as strictly dyadic variables both mother-based and infant-based variables were represented. An inspection of the variables which showed positive but nonsignificant correlations suggests that attention to quietness (MIB to Q/A), proximal stimulation (affect), infant play and maternal attention to play might be aspects of optimal functioning for the SFD infants. Table 34 highlights the differential relationships of interactions for SFD and fullterm dyads; the three infant-based variables indicate the salience of infants' attention to objects rather than mothers.

At two and three months there was a preponderance of infant-based variables which related to ten-month development. By six months though, there appears to be a more even balance of influence on interaction, which suggests an increased sensitivity to maternal stimulation. The influence however appears to be adverse, and in comparison with preterm dyads is slight.

In further comparison with the preterm group, the significant infant-based variables for both groups indicate that for preterm infants action was optimal (in fact infant quiescence was negatively related) whereas for SFD infants inaction, or at least quietness, was an advantage (though the evidence for this is only suggestive). Clearly for both groups, dyadic interaction was not a characteristic of high-scoring infants, and Table 35 suggests that underlying this common feature were subtle differences. Infant actions which were social (smiling, vocalising, and interacting with maternal looking) were positive characteristics of high-functioning preterm infants but not of their SFD counterparts; and maternal affectionate behaviours which were probably calming tended to be associated with low-scoring preterm and high-scoring SFD infants.

III OVERVIEW OF RELATIONSHIPS BETWEEN INTERACTION AND COGNITIVE PERFORMANCE

There is a general assumption that the nature of parent-child and in particular, mother-infant interaction is important for development. A great deal of research effort has gone into understanding differences in styles between groups of dyads considered "at risk" through compromised neonatal status (e.g. prematurity, perinatal complications), and socioeconomic status, with the underlying assumption that differences found among interaction styles might account in some way for later problems such as developmental delay, social and emotional difficulties, or vulnerability to child abuse. Undoubtedly difficulties in interaction can be discouraging and problematic for parents, however so far investigation into the precise relationships between interaction and intellectual functioning, for example, is limited to a few research reports. The work of Lewis and his colleagues (Lewis et al, Coates and Lewis 1984) has demonstrated the differential effects of maternal responsivity measures on development in fullterm infants at three months and six years; in particular early proximal interactions were positively related to three-month cognitive performance but negatively related to six-year scores, while the opposite relationships held for distal interactions. Coates et al point out that

> "Maternal social interaction cannot be characterised as a single entity since some types of interactions may facilitate some skills and not others and some may influence skills at one age but not another." (pp 1228).

Lewis et al were concerned with the interplay of infant congnitive status and environmental experiences on subsequent competence; there is however also the issue of differential infant contribution to environmental experiences. Wachs and Gandour (1983) studied 100 normal six-month old infants and found that infants characterised as temperamentally easy showed a greater sensitivity to the social and physical environment (in terms of the relationships between environmental factors and intellectual development) than temperamentally difficult infants; for the "difficult" infants there were very few correlations between intellectual performance and observations of social stimulation and physical environment whereas "easy" infants despite similar levels of cognitive development, showed clear relationships between development and concurrent social and physical factors. Furthermore, "easy" and "difficult" infants related differentially to the same environmental factors; the difficult group had several negative relationships between social variables and development, many of which were significantly different from the corresponding correlations for the easy group.

The results of the study reported here also indicate differential patterns of influence and response for fullterm, preterm, and SFD infants. The data in this chapter suggest three possible general models of development. Figure C indicates an even and stable process of influences on ten-month MDI scores for fullterm infants. Interaction variables at two, three and six months all contribute, as do SES factors and earlier (four-month) cognitive status. Early interactive variables such as simultaneous interaction levels have a differential effect on four-month and ten-month development, but maternal stimulation factors have a steadily beneficial influence.

In contrast, the influences on ten-month development for preterm infants (Figure D) seem to be most potent at six, rather than three months. Maternal stimulation and interaction have an increasingly negative impact, and infant vocalising at both ages indicates high levels of cognitive functioning at ten months. The salience of

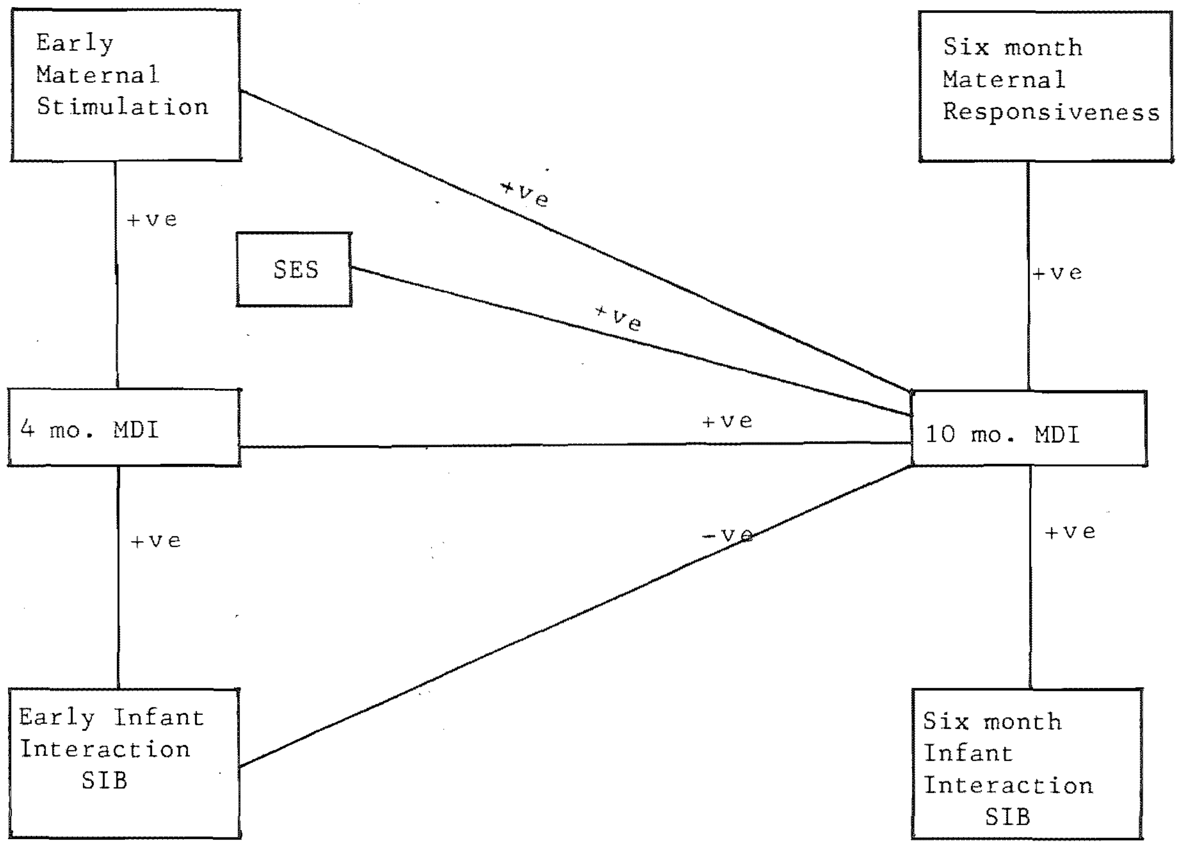


FIGURE C : MODEL FOR INFLUENCES ON DEVELOPMENT: FULL TERM GROUP

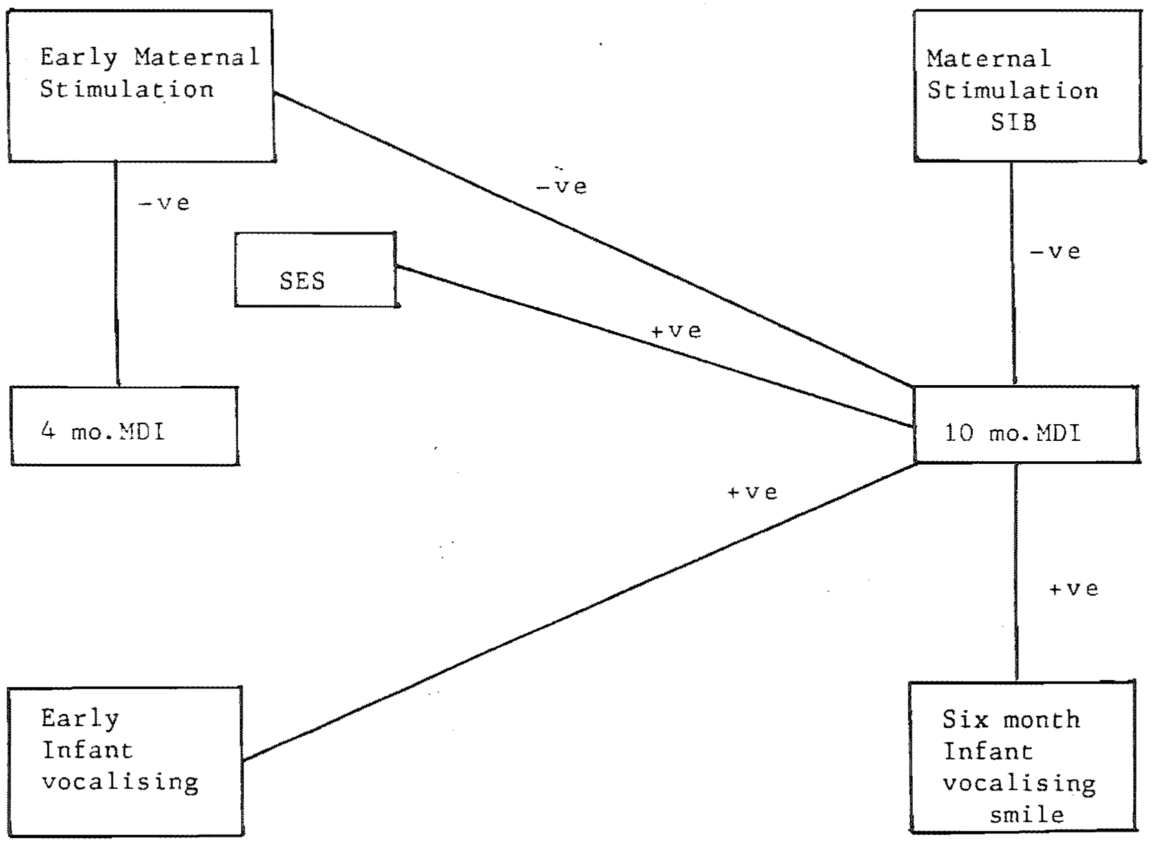


FIGURE D : MODEL FOR INFLUENCES ON DEVELOPMENT: PRETERM GROUP maternal factors is underlined by the relationship between SES and development, and the cumulative effects of early factors plus the comparative insensitivity of the infant to these in the early months is indicated by the lack of correlation between four-month and ten-month MDI scores.

Figure E indicates a third model of influence for SFD infants. In this group early factors, and particularly infant factors, appeared to be most potent. Early maternal variables measured here had no apparent influence on ten-month development, and six-month maternal behaviour and dyadic interaction had a negative impact. The early cognitive performance of these infants contributed to ten-month MDI scores as it did for the fullterm group; the effect of early infant and interactive factors however is cumulative and does not directly influence four-month performance. The comparative strength of influence of infant factors is underlined by the lack of effect of SES status.

The processes of development are clearly different for these groups of mothers and infants. The assumed beneficial effects of maternal stimulation in the early months are evident only for the fullterm infants; in both "at risk" groups maternal social signals and dyadic interaction appear counterproductive for cognitive functioning, though for different reasons. One can speculate that the preterm infants find social input difficult, and rather easily "close down" if not allowed

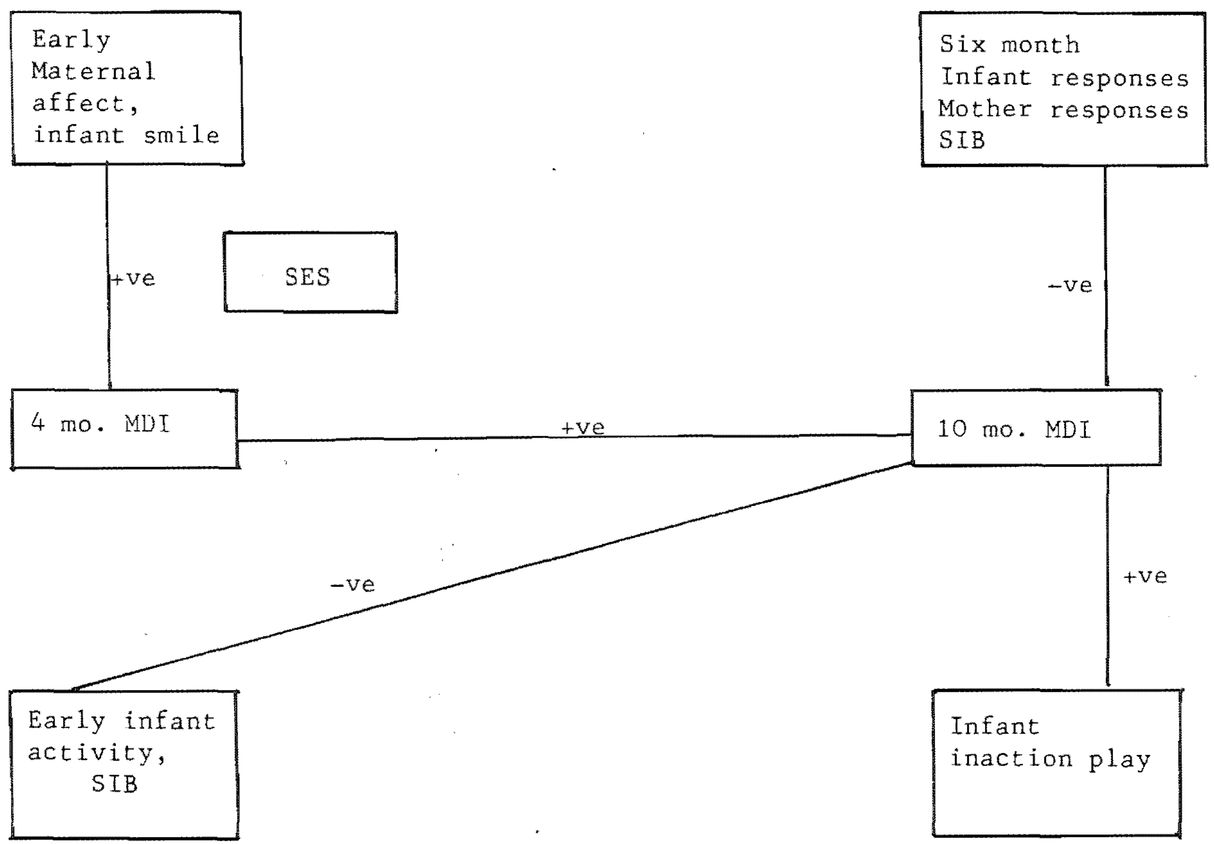


FIGURE E : MODEL FOR INFLUENCES ON DEVELOPMENT: SFD GROUP frequent pause and opportunity to initiate interaction at their own pace. Yet infant action is important, and maternal behaviour which has a quietening effect such as responding to fussing, and stroking and touching, is likely to discourage action in these preterm infants; thus encouragement to action might be beneficial.

Whereas the negative effect of maternal stimulation seems to be in the tendency for the preterm infant to become less active, activity levels in the SFD infants appear to be inimicable with optimal intellectual functioning. Maternal stimulation may heighten SFD infant activity although this is not clear from the results; early maternal soothing behaviours are beneficial, and the overall impression for the SFD group is that mothers who can find ways of quietening their infants and encouraging their attention to play rather than social interaction at six months will be assisting their infant's intellectual development.

CHAPTER VII

ASSESSMENT OF INFANT TEMPERAMENT

At six months (corrected age for the preterm group), mothers of infants in the three groups were asked to complete the Revised Infant Temperament Questionnaire (RITQ) (Carey and McDevitt 1978). Completed questionnaires were returned for ten fullterm infants, nine SFD infants, and thirteen preterm infants.

I RESULTS

The scored questionnaire allows categorisation of infants as easy, difficult, slow to warm up (STWU), and intermediate, with the intermediate being further divided into intermediate-low (easy) and intermediate-high (difficult). The difficult and easy categories are based on five of nine dimensions assessed in the questionnaire; they are rhythmicity, approach, adaptability, intensity, and mood.

For the total sample, eleven infants (34.4%) were scored as easy; seven (21.9%) as difficult; five (15.6%) as STWU; and nine (28.1%) as intermediate. This compares with Carey and McDevitt's findings of 42.4% easy, 9.4% difficult, 5.9% STWU, and 42.3% intermediate.

(1) Group Scores

The fullterm group scores were 30% easy, 30% difficult, 10% STWU, and 30% intermediate, showing higher percentages of difficult and STWU infants than Carey and McDevitt's sample.

In the preterm group, 38.5% were easy, 7.7% were difficult, 15.4% STWU and 38.5% intermediate. In the SFD group 33.3% were easy, 33.3% were difficult, 22.2% STWU and 11.1% imtermediate.

Table 36 displays group differences for ratings on individual dimensions of temperament. The SFD infants were scored as more withdrawing, more intense, and having lower thresholds than the preterm infants; the preterm infants had higher thresholds than either the fullterm or the SFD group.

(2) Maternal Global Ratings of Temperament

The RITQ includes questions on maternal ratings of infants on the nine specific dimensions covered by the behaviour questionnaire, and on assessment by the mother on her infant's temperament as "above average", "more difficult than average", or "easier than average". Comparison of maternal impressions with the RITQ score for the 24 mothers who completed this questionnaire shows that 41.7% of mothers described their infants more optimally than the RITQ rating; 41.7% gave the same assessment, and 16.6% rated their infants less optimally

TABLE 36

MEANS, STANDARD DEVIATIONS, AND SIGNIFICANT GROUP DIFFERENCES FOR RATINGS ON INDIVIDUAL DIMENSIONS OF TEMPERAMENT

DIMENSION	FULLTERM		PRETERM		SFD		SIGNIFICANT GROUP DIFFERENCES
Activity	4.3	.5	4.2	.8	4.6	.5	
Rhythm	2.8	.7	2.5	.7	2.9	1.0	
Approach	2.6	.7	2.2	.7	2.8	..6	Preterm/SFD p=.1
Adaptability	2.4	.6	2.1	.6	2.5	.8	
Intensity	3.4	.6	3.2	.3	3.6	.6	Preterm/SFD p=.1
Mood	2.9	.5	3.1	.5	3.2	.6	
Persistence	3.1	1.0	3.4	.5	3.3	.9	
Distract-ibility	2.3	.4	2.3	.3	2.3	.6	
Threshold	3.8	.8	3.2	.7	3.7	.5	Preterm/Fullterm p=.2 Preterm/SFD p=.2

than the RITQ score. Of those who rated their infants less favourably, all described infants who had scored as "easy", as having average temperaments. Further, all these infants were either preterm or SFD. It is also of interest to note that of the seven infants in the total sample rated as difficult, only two had had negative Neonatal Perception Inventory (NPI) Scores, and both of these were in the SFD group.

(3) RITQ Dimensions and NPI Scores

The questions asked in the NPI cover areas of behaviour involved in the RITQ dimensions, especially rhythmicity, mood, and persistence. It was decided to look at the relationships between NPI scores and scores on individual RITQ categories. Table 37 shows the Pearson-Product-Moment correlations for these. It is important to note that a low score on the temperament is optimal, and that high scores reflect more "difficult" ratings. All tests of significance used the two-tailed test. Few systematic significant relationships were found. For the total sample, mood was inversely related to NPI score i.e. positive mood was positively related to neonatal perception ($r = -.3746$ $p = .05$ two-tailed test). In the fullterm group high activity levels and high persistence were positively related to neonatal perception scores. For the SFD infants the opposite relationship applied for persistence; low levels of persistence were positively related to neonatal perception. The correlations for persistence and NPI for the fullterm and SFD groups were significantly different ($z = 3.3692$ $p = .001$). The preterm group showed a positive relationship between

TABLE 37
CORRELATIONS BETWEEN NEONATAL PERCEPTION INVENTORY SCORES AT ONE MONTH OF AGE AND INFANT TEMPERAMENT QUESTIONAIRE DIMENSIONS AT SIX MONTHS

DIMENSIONS	FULLTERM	PRETERM	SFD
Activity	.7950*	.4817	-.3615
+Rhythmicity	-.5054	.7325*	.0210
+Approach	.1868	.3180	-.2826
+Adaptability	.5194	.4202	-.5118
Intensity	.3277	-.2195	-.4887
+Mood	-.4703	-.2618	-.5666
+Persistence	-.6848*	.2058	.7810**
+Distractibility	.1735	-.2494	-.4448
+Threshold	.2570	.0952	.0604

* p= .05
**p= .02
\+ Higher values mean low ratings on these categories.

neonatal perception and arrhythmia.

A total score for temperament for each infant was obtained by adding the individual scores on the easy-difficult dimensions (rhythmicity, approach, adaptability, intensity, and mood). This total score represents a position on the continuum between easy and difficult temperaments, and was described by Thomas et al (1982). Correlations between NPI scores and temperament scores were:

Fullterm group	.0034
Preterm group	.3308
SFD group	-.4865

(4) RITQ Dimensions and Stability of Neonatal Sleep States

Relationships between rates of sleep state change in the neonatal period, and RITQ dimension scores, were considered. Table 38 shows the correlations obtained.

No relationships were found for the fullterm group. For the preterm infants however three of the five dimensions used in determining easy and difficult temperaments showed significantly negative relationships to rate of sleep state change i.e. high levels of sleep state change were positively related to rhythmicity, approachability and adaptability. There was also a strong relationship for preterm infants between high rates of sleep state change and high persistence. The SFD group showed a relationship between sleep state change and mood, with positive mood correlating positively with sleep state instability.

TABLE 38
CORRELATIONS BETWEEN RATES OF SLEEP STATE CHANGE
IN THE NEONATAL PERIOD AND INFANT TEMPERAMENT QUESTIONNAIRE
DIMENSIONS AT SIX MONTHS

DIMENSIONS	FULLTERM	PRETERM	SFD
Activity	.2897	.1809	.0753
+Rhythmicity	-.3875	-.8380***	.2859
+Approach	.1498	-.6859*	-.2874
+Adaptability	.3468	-.7234*	-.0529
Intensity	.2810	.4176	.4324
+Mood	.1262	.1256	-.7134*
+Persistence	.3387	-.8776***	-.5713
+Distractibility	.4437	.0254	.6086
+Threshold	.0913	.4928	.4183

+High values mean low ratings on these dimensions.

When total temperament scores on the easy-difficult dimensions were compared with rate of sleep state change, the following correlations were obtained:

Fullterm group:	$r = .1873$	
Preterm group:	$r = -.5962$	$p = .1$
SFD group:	$r = .0098$	

(5) RITQ Dimensions and MDI Scores

There were no significant relationships between RITQ dimensions and four-month Bayley Mental Development Index (MDI) scores (see Appendix 3). However for the SFD and fullterm group combined, four month development was significantly correlated with arrhythmicity ($r = .511$ $p = .05$).

Table 39 shows the correlations for ten-month MDI scores and RITQ dimensions. In the fullterm group NPI scores were positively related to adaptability. However the opposite relationship applied for the other two groups; development appeared to be related to slow adaptability. The correlations for the fullterm and preterm groups were significantly different ($z = 2.9138$ $p = .01$), as were those for the fullterm and SFD groups ($z = 2.76$ $p = .01$). The correlation for the preterm and SFD groups combined on this dimension is $r = .5194$ ($p = .05$). The positive correlations for the rhythmicity dimension indicate that optimal development was significantly related to arrhythmicity for preterm and SFD infants; for the total sample the correlation is $r = .4955$ $p = .01$; hence there appeared to be a strong

TABLE 39
CORRELATIONS BETWEEN TEN MONTH MDI SCORES AND INFANT TEMPERAMENT QUESTIONNAIRE DIMENSIONS AT SIX MONTHS

DIMENSIONS	FULLTERM	PRETERM	SFD
Activity	.0787	.4003	.6964**
+Rhythmicity	.3063	.6709**	.5855*
+Approach	-.3989	.4808	.2407
+Adaptability	-.7009**	.6375*	.6512*
Intensity	.2647	.0046	.4438
+Mood	-.2819	-.2438	.2245
+Persistence	-.2679	.4470	.1789
+Distractibility	-.1987	-.3459	-.1446
+Threshold	.1507	-.0213	.1928

+ Higher values mean lower ratings on these dimensions

* p=.1
**p=.05

relationship between arrhythmicity and development at ten months for all infants. There was also a positive relationship for the SFD group between ten-month MDI scores and activity levels.

Total temperament scores were compared with MDI scores. For the fullterm group $r = -.3204$; for the preterm group $r = .4162$; for the SFD group $r = .6931$ ($p = .05$). The correlation for the preterm and SFD infants combined was .4684 ($r = .05$). This is significantly different from the fullterm temperament-MDI correlation ($z = 2.129$ $p = .05$).

(6) <u>Temperament Ratings and Interaction Variables</u>

The relationship between perceived temperament and mother, infant and interaction behaviour is central to a clarification of the nature of temperament (see the literature review for discussion). It was decided therefore to investigate the relationships between earlier infant, mother and interactive variables and six-month temperament ratings, and between concurrent interaction behaviour and temperament ratings.

(a) <u>Infant Behaviour</u> Tables 40 and 41 display the correlations between two, three and six-month infant behaviour, and six-month temperament ratings. For the fullterm group infant smile at two months was related to difficult temperament; at six months waking active state was related to difficult temperament, and quiet alert state to easy temperament ratings. The waking active and quiet alert correlations were significantly different for this group ($z = 2.9203$ $p = .01$).

The preterm group showed infant smile at two months to be positively related to easy temperament ratings; the correlations for fullterm and preterm groups were significantly different on this variable ($z = 2.8667$ $p = .01$). No other infant variables were significant for the preterm group although there was a tendency at six months for the state variables (waking-active and quiet-alert) to be related in the opposite direction from the fullterm group.

In the SFD group several variables correlated with temperament ratings. Waking active state and infant vocalising at two months were related to easy temperament, with waking-active remaining significant at three months. Fuss/cry, fussing and state change were related to difficult temperament at two months in this group. No six-month infant variables were correlated with temperament ratings in the SFD group.

(b) <u>Maternal Behaviour</u> Table 40 and 41 show the relationships between maternal behaviour and temperament ratings at two, three and six months. No two or three-month variables were related for the fullterm group; at six months affectionate behaviour was related to difficult temperament.

TABLE 40
CORRELATIONS BETWEEN TOTAL TEMPERAMENT SCORES AND TWO AND THREE MONTH INFANT AND MATERNAL BEHAVIOUR VARIABLES

INFANT BEHAVIOUR	FULLTERM	PRETERM	SFD	MATERNAL BEHAVIOUR	FULLTERM	PRETERM	SFD
W/A 2mo	.0817	-.2538	-.8552***	Smile 2mo	.2758	-.2435	+-
3mo	.0411	-.0141	-.7980**	3mo	.0919	.0612	.0705
Q/A 2mo	.3859	.0040	-.5284	Look 2mo	-.4730	.3430	.1889
3mo	.0305	.0824	-.0115	Infant 3mo	.3628	-.2409	.5334
Drowse 2mo	-.3518	.4959	.1551	Vocalise 2mo	-.5788	-.1670	.4593
3mo	.2812	-.1511	.5346	Infant 3mo	.0095	-.6200*	.2897
F/C 2mo	-.3057	-.0077	.6345*	Affect 2mo	-.2783	.2054	.5267
3mo	-.5133	-.2707	.4496	3mo	.1255	-.4683	.5424
Look 2mo	-.2734	.0801	-.1512				
Mother 3mo	-.1942	.1292	-.5338				
Voc 2mo	.4053	-.3985	-.6989*				
3mo	.4874	.0489	-.2699				
Smile 2mo	.6332*	-.7234**	-.2585				
3mo	.3697	.3742	.0848				
Fuss 2mo	-.1666	.4811	.9231***				
3mo	-.0819	.2650	.1503				
State 2mo	-.1796	-.1556	.7393*				
Change 3mo	.4600	-.2780	.2784				

+No smiling recorded for SFD mothers at two months. *p=.1 **p=.05 ***p=.01

TABLE 41

CORRELATIONS BETWEEN SIX MONTH INFANT AND MATERNAL BEHAVIOUR AND TOTAL TEMPERAMENT SCORES AT SIX MONTHS

INFANT BEHAVIOUR	FULLTERM N=10	PRETERM N=9	SFD N=9	MATERNAL BEHAVIOUR	FULLTERM N=10	PRETERM N=9	SFD N=9
W/A	.5555*	-.5052	.0581	Look	-.1682	-.3305	.4901
Q/A	-.5932*	.5057	-.3311	Vocalise	-.2791	-.2090	.8112***
State Change	-.3170	.0416	.0178	Play	.0576	-.3987	.2004
Look	.0435	-.0841	-.4339	Affect	.6891**	.0550	.5708
Vocalise	.4191	-.0608	-.1850	Smile	.2704	-.1885	-.1935
Play	.4634	.1423	.2857				
Look Objects	-.4628	.2553	.1229				
Look Observer	-.4469	.0561	-.2502				
fuss	-.2141	-.3790	.5669				
Smile	-.2370	-.1139	-.2322				

*p=.1, **p=.05, ***p=.01

At three months preterm mothers vocalised significantly more to easy than to difficult infants; however no maternal behaviour at six months was related to temperament.

In the SFD group there was a tendency for mothers of difficult infants to be more affectionate at two, three and six months. For the total sample there was a significant relationship at six months between affectionate behaviour and difficult temperament ($r = .3813$ $p = .05$). Mothers of SFD infants also vocalised more to their difficult infants.

(c) <u>Interactive Variables</u> Tables 42 and 43 show the correlations between temperament ratings and interactive variables at two, three and six months. In the fullterm group there were no significant relationships, though there was a tendency for Maternal Interactive Ratio (MIR) to be related to difficult temperament.

The only significant relationship in the preterm group was between infant signalling alone (IIB alone) and difficult temperament at three months. In the SFD group several relationships existed. Infant signalling alone (IIB alone) was positively related to easy temperament ratings at two and three months but not at six months. Maternal signalling alone varied in the same direction as difficult temperament at two, three and six months (though this relationship failed to reach significance at three months). Infant interactive behaviour to maternal looking

TABLE 42

CORRELATIONS BETWEEN TOTAL TEMPERAMENT SCORES AT SIX MONTHS AND TWO AND THREE MONTH INTERACTIVE VARIABLES

INTERACTIVE VARIABLE	FULLTERM N=10	PRETERM N=9	SFD N=8
MIB to 2mo	-.0791	.2535	.3875
1/m voc 3mo	.1032	-.5101	.4328
IIB to 2mo	.0447	-.2321	-.4608
1/b voc 3mo	.0100	.0469	-.7519**
SIB 2mo	-.2741	-.1374	.3439
3mo	-.0623	-.0831	-.1619
SI 2mo	-.3489	.0230	-.1562
3mo	-.2442	-.0682	.0240
IIB 2mo	.2071	-.1213	-.6791*
3mo	.0288	.6061*	-.6631*
MIB 2mo	-.2734	-.0922	.6572*
alone 3mo	.0612	-.3829	.5461

p=.1
p=.05

TABLE 43
CORRELATIONS BETWEEN TOTAL TEMPERAMENT SCORES AT SIX MONTHS AND SIX MONTH INTERACTIVE VARIABLES

INTERACTIVE VARIABLE	FULLTERM N=10	PRETERM N=9	SFD N=8
IIB alone	.3289	.2271	-.1566
MIB alone	-.3698	-.1684	.7901***
MIB to voc	.0802	.0644	.5016
IIB to voc	.2701	.0264	-.2936
Infant response	-.2530	.4420	-.2774
Maternal response	.0763	.0281	-.0272
IIR	-.1510	-.3351	.3170
MIR	.5152	-.0357	-.5818
SI	.2084	-.2978	-.4900
SIB	.0001	-.4497	.1242

***p=.01

and vocalising (IIB to 1/b, voc) was correlated with easy temperament in the SFD group, and although the correlation between MIR and easy temperament failed to reach significance, it was significantly different from the same correlation in the fullterm group ($z = 2.22$ $p = .05$).

II DISCUSSION OF RESULTS

(1) Total and Group Scores

In the percentages for the total sample, the difficult and STWU categories were over-represented in comparison with the findings of Carey and McDevitt's original (North American) sample. The individual group scores show that the fullterm and SFD groups had disproportionate levels of these categories; however comparison with such a small sample does not permit conclusions to be drawn on the grounds of cultural or infant-group differences.

Of more interest are the group differences on individual dimensions. The SFD infants were significantly more intense, withdrawing and reactive (lower thresholds) than the preterm group, all of which features allude to potential difficulties in interaction. These differences concur with the suggestion in Chapter V that SFD infants were more passive in interactions with their mothers; in turn the finding that preterm infants had higher thresholds of reaction than SFD and fullterm infants indicates an unresponsive aspect of their interactive style.

The general finding here that there were no differences between temperament scores for the fullterm and preterm groups accords with the findings of Roth, Eisenberg and Sell (1984) who noted similar scores for preterm and fullterm infants at twelve months, on both individual dimensions and total temperament ratings. The study by Field et al however found that preterm infants at four months were rated more adversely than control group infants. The difference may lie in the fact that the preterm infants in the Field study had all suffered from Respiratory Distress Syndrome.

(2) Maternal Global Impressions vs. Temperament Ratings

The finding that many mothers tended to have a more favourable impression of their infants' temperament than the rating scale would suggest is in accordance with the findings of Thomas et al (1982), McDevitt and Carey (1981), and Maziade et al (1984). In particular mothers of "difficult" infants seemed to minimise any problems posed by such infants. In this study, if infants rated on the scale as difficult, intermediate-high, and STWU are considered, 50% of them were described as having average temperaments, 41.7% as being easy, and 8.4% (one) as being difficult. These figures are comparable with those of Maziade et al who, in a large sample, found that 68% of mothers of difficult infants rated their temperaments as average, and 36% reported they had no problems. Since all subjects were first-born it is probable that their mothers considered their infants' behaviour to be normal in the absence of siblings for comparison, and this was particularly notable in the case of the preterm and SFD infants (though the four infants rated adversely by their mothers were in these groups). Although none of the fullterm mothers assessed their infants globally as more difficult than the rating scale, there was a high incidence of difficult infants in this group. It is possible that fullterm mothers do not "expect" to have difficult infants whereas the awareness of having a preterm or SFD infant might have caused some mothers in these groups to expect their infants to pose some problems. However numbers in these samples are too low to form even tentative conclusions. It is, though, notable that so many mothers showed a discrepancy between global and specific ratings of temperament; this suggests at least an element of objectivity in the rating scale.

(3) RITQ Dimensions and NPI Scores

The Neonatal Perception Inventory (NPI) was completed by mothers when the infants were one month old. It consists of six questions about day-to-day functioning, and which relate to mood, rhythmicity, and persistence. The relationship for the total sample between mood and NPI suggests the salience of irritability for mothers, since the question in the NPI most directly related to mood is concerned with the amount of crying the infant does.

Several questions in the NPI bear on the rhythmicity dimension; in particular one which asks how much trouble the infant has had in settling down to a predictable pattern of eating and sleeping. There was a significant difference between the correlation for the fullterm and preterm groups for rhythmicity ($z = 2.6798$ $p = .01$); clearly for the fullterm infants rhythmicity in the neonatal periods was related to perceptions of rhythmicity at six months. The opposite relationship for the preterm group might be concerned with the practice of imposing patterns of feeding on these infants who are often sleepy in the neonatal period and who are woken regularly for feeds. The infant who has a relatively strong rhythmic style of its own may resist the imposed pattern to a greater extent than a comparatively arrhythmic infant, hence the adverse rating in the neonatal stage.

The significantly different relationships between NPI scores and persistence for the fullterm and SFD infants are difficult to explain, as none of the NPI questions has direct relevance to this dimension. Ease of feeding, for example, might be a function of high or low persistence in the infant whereas ease of sleeping might be related to low persistence. In general, a style which was non-persistent in the SFD infant who is typically confused in state control and behaviour organisation might have been perceived favourably by the SFD mothers.

The lack of relationship between NPI scores and total temperament ratings is explained by the fact that the six questions in the NPI do not cover the dimensions relevant to the easy-difficult categories. In fact two dimensions outside these categories (activity and persistence) have been shown here to be correlated with the NPI.

(4) RITQ Dimensions and Sleep State Stability

There is a striking pattern of correlations for the preterm group between high rates of sleep state change in the neonatal period and three of the five dimensions of easy temperament, and the total-temperament-score relationship with sleep state change confirms this pattern.

There is little evidence with which to compare this finding. Meares et al (1982) found that measures of state control on the Brazelton Neonatal Behavioural Assessment Scale (Als, Tronick, Lester and Brazelton 1977) were related to NPI scores in normal infants. The state control measure is an indication of the neonate's capacity to control states of consciousness, and may bear little relation to sleep state instability, although in this study for preterm infants sleep state stability was related to NPI scores ($r = .5482$ $p = .05$). However there is no obvious explanation for the strong finding that sleep state instability is correlated with aspects of easy temperament in these infants until further evidence is considered.

Neither is it apparent why positive mood should be positively related to sleep state instability in the SFD group; this may well be a chance finding particularly as there were no systematic relationships between sleep state stability and other measures for this group.

(5) RITQ Dimensions and Ten-Month MDI Scores

There is a striking difference between the relationships for the two at-risk groups and the fullterm group between ten-month MDI scores and ratings on the easy - difficult temperament dimension. For both preterm and SFD infants arrhythmicity and low adaptability were positively related to intellectual performance, with high activity significantly related for the SFD group and tending to be so for the preterm group. The overall trend is indicated by the total-temperament scores and their correlations with MDI scores.

Roth et al also found that temperament ratings (at twelve months) were related to MDI scores in preterm but not fullterm infants, and relationships were between the same dimensions (rhythmicity and adaptability) as in this study. However whereas easy (rhythmic and adaptable) infants scored highly in the Roth et al study the opposite effect was found here.

Arrhythmicity appeared to be important for development at both ages (four and ten months) since it showed significant relationships for the total sample with MDI scores. An inspection of tasks performed in the Bayley scale assessment at these states reveals no apparent connection with this dimension. Relevant questions on the RITQ are concerned with amounts and timing of food, sleep and bowel movements. It is possible from the mother's point of view that the predictability of a rhythmic infant does not encourage spontaneity or novelty of experience to the same extent as an infant whose sleeping and feeding times are variable, and can thus be more easily accommodated to a varied and more stimulating life-style.

One can speculate further that the relationship between low adaptability and MDI scores for the preterm and SFD infants was mediated by the mothers' response to the infants' inability to adapt quickly to changes in food, surroundings and people. The infants' resistance to rapid change may modulate stimulation to a level which can be processed more easily thus facilitating intellectual development, whereas a more adaptable preterm or SFD infant might be unable to accommodate the changes that the adaptability allows.

The overall relationship between difficult temperament and high MDI scores for the preterm and SFD infants does not accord with some other research. Field et al (1978) found that easy temperament ratings at four months for preterm and postmature infants predicted optimal intellectual functioning at twelve months. However Peters-Martin and Wachs (1981) noted that infants rated as more difficult at twelve months were at a higher developmental level than those rated as easy. Furthermore Milliones (1978) reported that difficult infants had more responsive mothers at twelve months, and maternal responsiveness has been found to affect intellectual development (see for example Lewis and Coates 1980). The lack of relationship between temperament rating and MDI for fullterm infants accords with the findings of Daniels et al (1984).

(6) Temperament Ratings and Interaction Variables

Tables 40 and 42 demonstrate the remarkable predominance of significant relationships for the SFD group between infant, maternal and interactive variables at two and three months and temperament at six months. Although even at two months no variable can be regarded as either strictly infant or strictly maternal, most of the correlations were between temperament and infant-based variables. Several of these are state variables e.g. waking-active, fuss/cry and state-change rate. Vocalise, fuss, and infant interaction with maternal signals are infant-based; and MIB alone is a measure of the lack of infant response. Fuss/cry, fuss, rate of state change, and MBI alone were all positively related to difficult temperament which in turn was significantly correlated with high MDI scores, whereas vocalising, waking-active, IIB alone (lack of maternal response), and infant interaction with maternal signals, was positively related to easy temperament ratings. Only one maternally-based variable (IIB alone) at two and three months, was correlated with six-month temperament ratings for this group.

Only infant smile at two months was significantly related to temperament in the fullterm group, and its interest lies in the fact that there was an inverse relationship with infant smile in the preterm group. Easy preterm infants smiled more, and difficult fullterm infants smiled more. Also preterm mothers vocalised more often to easy infants and failed to respond (IIB alone) more often to difficult infants, at three months. The correlations for both fullterm and preterm groups are, however, remarkable for their sparseness in comparison with the SFD group.

An inspection of Tables 41 and 43 shows a comparative lack of correlations between six-month temperament ratings and concurrent interaction variables. There is a significant correlation for the total sample between maternal affectionate behaviour and difficult temperament, and this was foreshadowed at two and three months in the SFD group by correlations which just failed to reach significance. The relationship did not exist, however, for the preterm group. Behaviour rated as affection in the observations included touching, rubbing, patting and rocking, all of which might also serve a soothing quietening function, and it is possible that difficult preterm and SFD infants received high levels of these. At three and six months preterm mothers showed significantly less affectionate behaviour toward their infants anyway (see Tables 12 and 25).

Also notable is the inverse relationship for waking-active and quiet-alert states in the preterm and fullterm groups at six months. Difficult fullterm infants were most often in waking active, whereas difficult preterm infants were most often in quiet alert. This may be an indication of the mothers' perceptions of these different kinds of infants. The relative passivity in the early weeks of the preterm infant is perhaps seen as a problem, a perception which persists at six months and causes the preterm mother to see quietness as difficulty particularly for interaction. Conversely, by six months the mother of a fullterm infant may see activity as a dimension of difficulty.

Maternal vocalising and infant lack of response (MIB alone) were positively related to difficult temperament in the SFD group. MIB alone was also significantly related to difficult temperament at two months and just failed to reach significance at three months. Taken with maternal vocalising, this suggests that SFD mothers either tried but found interaction hard with these difficult infants, or perceived as difficult infants who were comparatively unresponsive. It is again notable that with the exception of the state variables and maternal affection in the fullterm group, only in the SFD dyads were behavioural relationships with temperament ratings found.

In a limited way these results permit speculation on some of the influences affecting maternal temperament ratings. However because of the few relationships found in the preterm and fullterm groups it is possible to discuss the process only for SFD infants.

It seems that for these infants major differences existed at two and three months between infant behaviour for easy and difficult infants. By six months most of these differences had disappeared, which suggests that maternal perceptions of temperament were based on real but early infant differences, several of which were state variables. Maternal differences in behaviour were small at both stages, suggesting that for this group perceived temperament differences were largely infant-based and were determined early in infancy. Campbell (1979) found differences in infant crying for difficult and easy infants at three but not at eight months in a group of fullterm infants; the difficult SFD infants in this study fussed more at two but not at three or six months.

Perhaps the most important aspect of these findings is that maternal perception of temperament is related to clearly different kinds of infant and maternal behaviour, depending on other factors in the infant - in this case, prematurity or smallness. Thus difficult fullterm and SFD, but not preterm, infants received high levels of maternal affectionate behaviour; infant smiling at two months was part of the perception of difficult fullterm, but easy preterm infants; difficult preterm infants but easy SFD infants signalled alone more often - and mothers of difficult fullterm but easy SFD infants had comparatively high interaction ratios (MIR). These results are too tentative to enable any firm conclusions about how mothers expect their compromised infants to behave; they do emphasise though that it is unrealistic to expect either that a category of temperament is a distinct phenomenon within the child, or that mother's behaviour toward a preceived kind of temperament will be the same.

The very few relationships found for the preterm and fullterm groups indicate that maternal perceptions of temperament must either have been very powerfully affected by infant smiling levels at two months or, as is more likely, was influenced by other sources including behaviour not observed here. In the preterm dyads, this study found that temperament ratings were significantly related to sleep state stability in the neonatal period, and to ten-month MDI scores. Neonatal Perception Inventory scores (NPI) for this group were also correlated with ten-month MDI performance ($r = .6360$ $p = .02$ two-tailed significance test), as was sleep state stability ($r = .4710$ $p = .1$ two tailed signficance test). Figure F depicts these relationships. The relationship between sleep state stability and intellectual development was mediated both by early maternal perception and by temperament; however NPI and temperament were not significantly related. In particular, difficult temperament seemed to be optimal for this group.

Figure G shows similar relationships for the fullterm group. The only significant relationship was between sleep state stability and negative neonatal

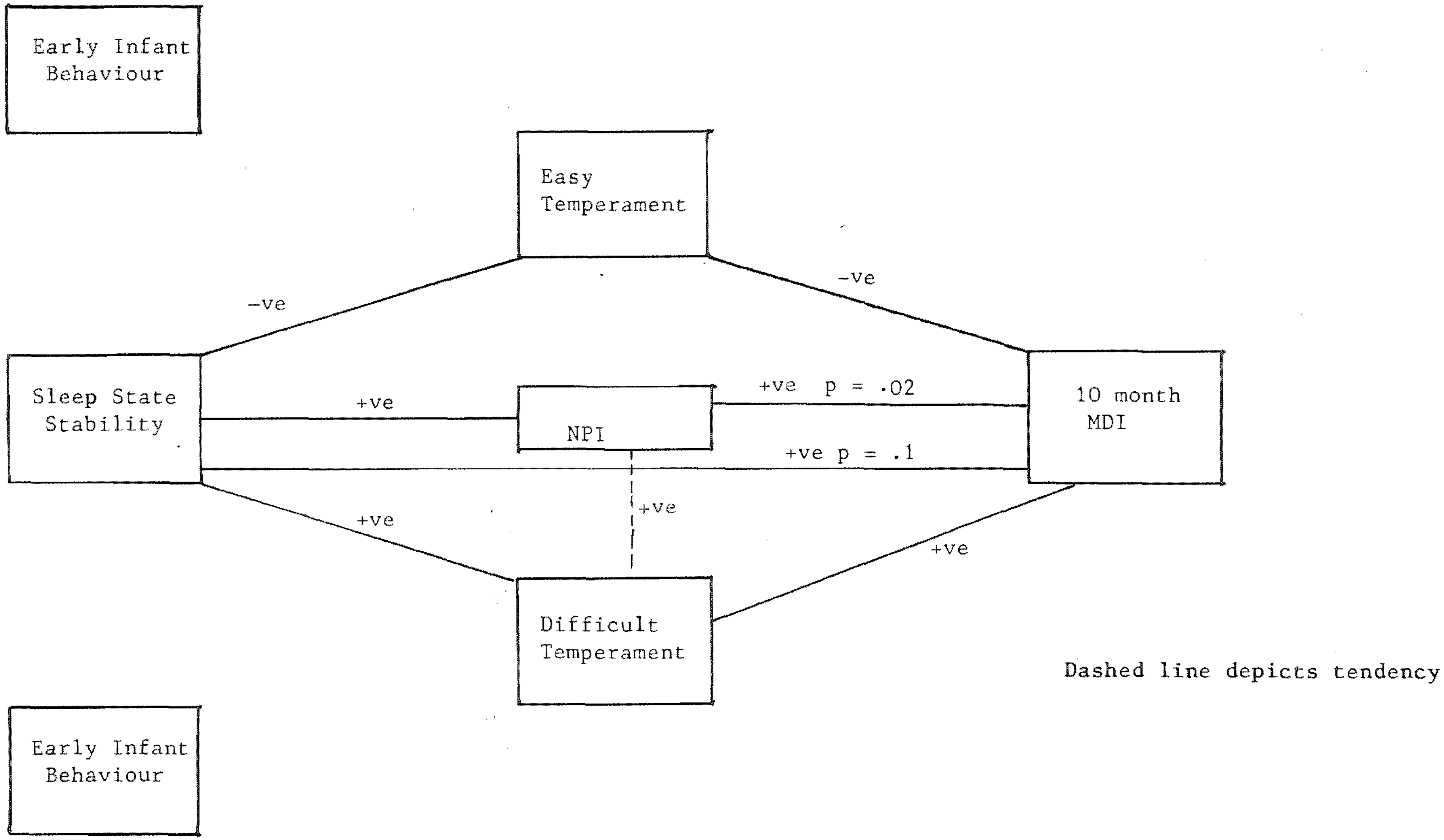


FIGURE F : MODEL OF RELATIONSHIPS FOR PRETERM GROUP AMONG TEMPERAMENT RATINGS AND OTHER FACTORS

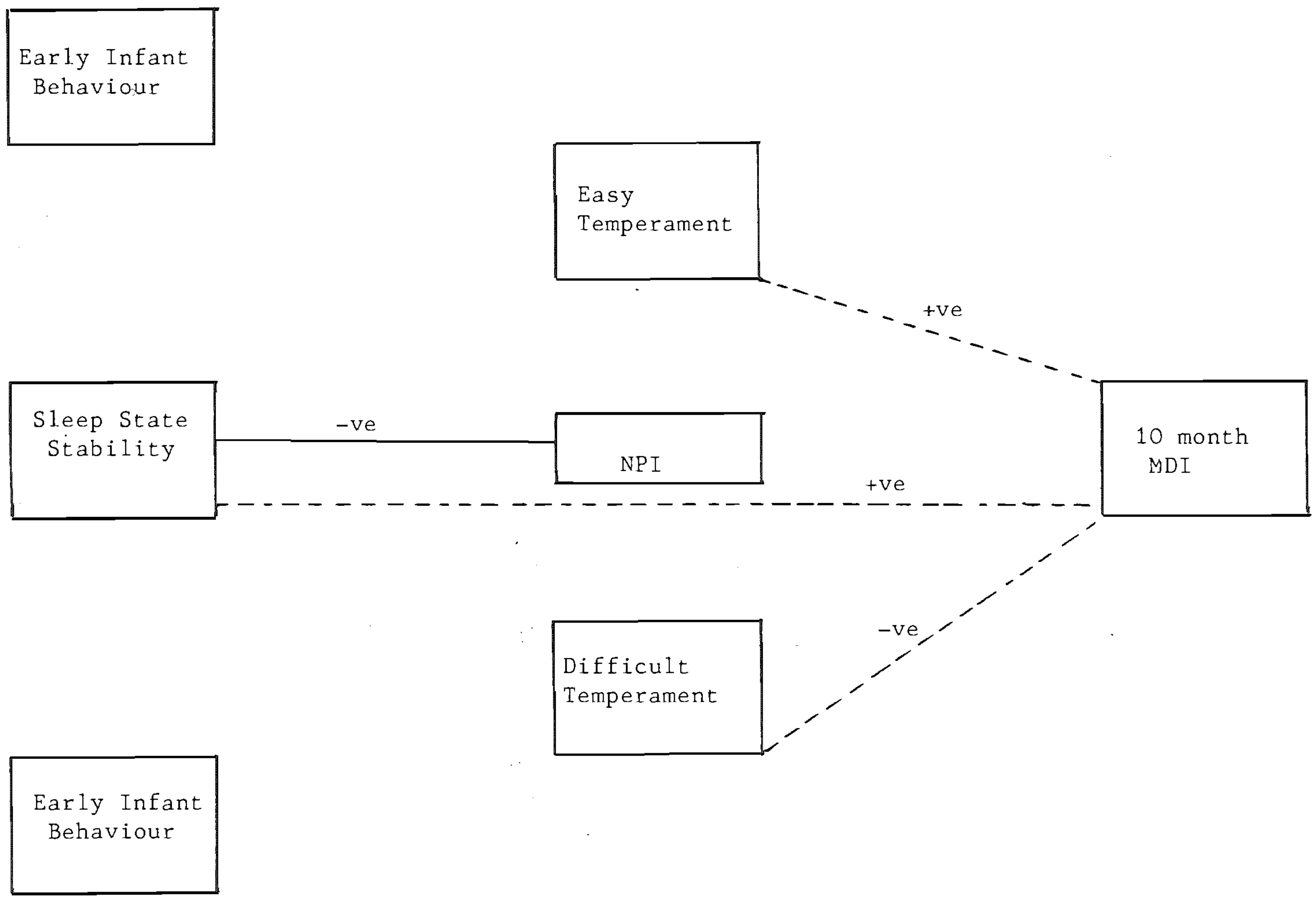


FIGURE G : MODEL OF RELATIONSHIPS FOR FULLTERM GROUP AMONG TEMPERAMENT RATINGS AND OTHER FACTORS

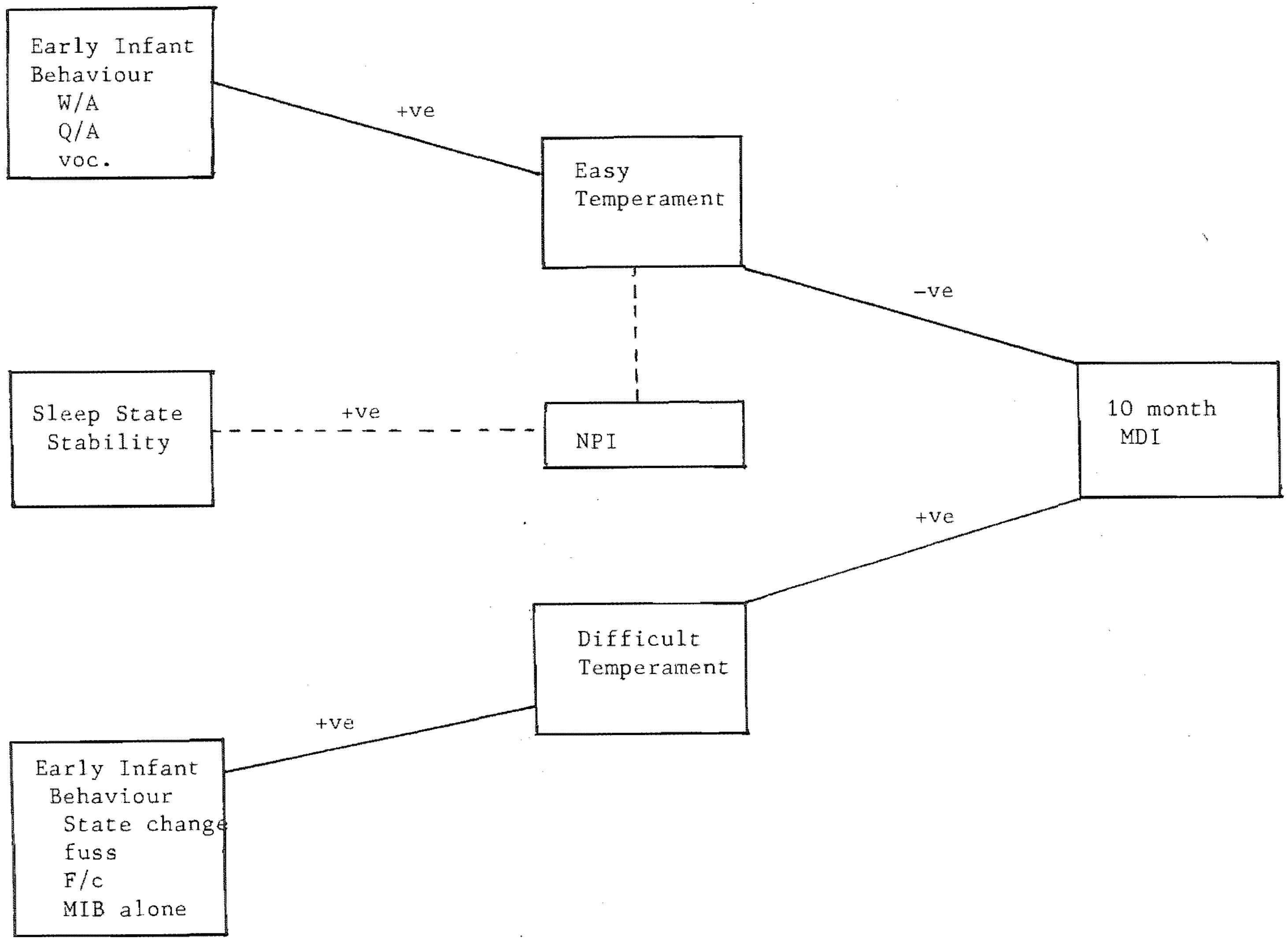


FIGURE H : MODEL OF RELATIONSHIPS FOR SFD GROUP AMONG TEMPERAMENT RATINGS AND OTHER FACTORS perception; there is no obvious explanation for this. Clearly, on these measures state stability, neonatal perception and temperament had little bearing on intellectual performance at ten months.

Figure H depicts some of the same relationships for the SFD group. The salience of early infant behaviour is obvious with temperament ratings mediating between that and ten-month development. This is in sharp contrast with the preterm group where sleep state stability and not early behaviour was important. Perceived temperament thus held a central position in development for both "at risk" groups, but not for the fullterm infants. Early infant behaviour variables for the SFD group, and sleep state stability and maternal perception factors for the preterm group, were important whereas there were few clear relationships among any of these for the fullterm infants. These results will be discussed further in Chapter VIII.

CHAPTER VIII

DISCUSSION

The findings in this study are complex and, because of the small sample size, tentative. The exercise was in an important sense exploratory in that it set out to elucidate, albeit suggestively, processes in the complex interplay in infants with subtle compromise at birth among several aspects of their social and emotional environment. The underlying aim was thus the comparatively modest one of generating hypotheses rather than testing them, hence the detailed observation of rather small numbers of infants.

Hypotheses did of course exist at the inception of the study and two of these are described as assumptions in Chapter II viz that preterm dyads have the same developmental course regardless of cultural offences, and that small-for-dates dyads develop in the same way as preterm dyads. Both assumptions are discredited to some extent by this research.

Many aspects of the study arise from other research, and the findings here will be discussed first as they stand, and then in the context of previous investigations.

I SUMMARY OF RESULTS

(1) Sleep Studies

The findings in this study largely confirmed those of other investigators for fullterm and preterm infants, with preterm infants at 40 weeks showing mixed characteristics of mature features (long quiet sleep periods), and unorganised aspects (high rates of sleep state change).

The SFD infants had high incidences of active sleep without REM compared with the other groups and high rates of state change compared with fullterm infants. The overall pattern for this group was one of neuro-physiological immaturity and disorganisation.

There was a negative relationship between maternal perception (measured by the Neonatal Perception Inventory) at one month and rate of sleep state change for the preterm group, i.e. high rates of sleep state change were part of an adverse maternal perception. However the opposite relationship applied for the fullterm group; high rates of sleep change were related to positive maternal perception at one month. The SFD infants had a negative relationship similar to the preterm group, though the correlation failed to reach significance.

(2) Mother-Infant Interactions: Two and Three Months

The preterm and SFD dyads were less synchronised and had lower levels of interaction than fullterm dyads at two and three months.

Preterm infant behaviour lagged behind fullterm infant behaviour; at two months preterm infants were less vocal, looked at their mothers less, and drowsed and fussed more than fullterm infants. But differences between the two groups of infants disappeared by three months in a corrected-age comparison. Preterm mothers who at two months showed similar levels of stimulation to fullterm mothers decreased their efforts at stimulation and were less synchronised with their infants at three months, so that low levels of interaction seemed to be based in maternal more than infant behaviour at three months.

SFD infants were more drowsy at two months than preterm infants, yet showed more interactive behaviour. SFD mothers stimulated their infants less at two months and more at three months than preterm mothers; lower levels of synchronised behaviour at three months in this group appeared to be the result of both infant and maternal signalling which was inappropriately timed, in contrast to the preterm group where predominantly maternal cues appeared to be mistimed.

(3) Mother-Infant Interactions: Six Months

By six months the interaction levels and synchronisation of behaviour was higher for preterm dyads than for fullterm dyads. Infant and maternal frequencies of signalling were similar to the fullterm group, but interactive variables such as mutual gaze were higher for the preterm group. However preterm mothers showed less affectionate behaviour toward their infants than other mothers.

SFD dyads had levels of interaction which were similar to the fullterm dyads. There was an overall impression however that SFD infants were comparatively passive in interaction.

(4) <u>Consistency of Behaviour</u>

The exploration of the consistency of variables was undertaken originally in order to confirm the validity of comparatively short observations, though consistency across concurrent observations would have been better for this purpose. Nearly 63 percent of the variables were consistent across the two-month to three-month period. However the more serendipitous finding was the pattern of consistencies for each group, with the SFD dyads showing twice as many consistent variables as the other two groups. Many of the SFD variables fell just short of significant consistency; only fourteen percent of the variables for this group were clearly inconsistent.

From three to six months only ten of 23 (forty-three percent) of the interaction variables were consistent for the total sample, and they were fairly evenly divided between being infant and maternally based. Again the SFD dyads showed the most consistency, although the preterm dyads also had several consistent variables. The fullterm dyads hovever showed no consistency at all, a finding which accords with the view that the early months of mother-infant interaction have a degree of flexibility which allows mutual adaptation to occur.

(5) Developmental Assessments

At both four and ten months the preterm and SFD groups showed lower levels of performance on the Bayley MDI than the fullterm infants. Four month and ten month scores were positively correlated for the total sample but a group analysis showed that this was not so for the preterm infants.

The four-month MDI scores were related to several two and three-month interaction variables for the fullterm and preterm groups. In the fullterm group there was a balance of infant and maternally based variables; in the preterm group several maternally-based variables were adversely related to four-month development. Only two variables in the SFD dyads were related to MDI performance at four months; they were maternal affection and infant smile.

Despite the positive relationship between four month and ten month MDI, a different set of two and three month variables was related to ten-month development in the fullterm group and apparently similar variables had inverse relationships with development at the two ages. Clearly, even for normal infants, development cannot be considered linear and there is considerable specificity in the timing and effect of many aspects of interaction. In the preterm group several variables reflecting maternal stimulation continued to be negatively related to ten-month development. In the SFD group correlations with two and three-month variables suggested a delayed negative influence of infant-based activity and dyadic interaction at that stage, at six months too several dyadic interactive variables and infant-action variables were negatively related to ten-month development. The patterns of influence between interaction and development in the first year were thus complex and were clearly quite different for the kinds of infant in this study. For both groups of infants considered at risk, normal mother-infant interaction appeared to be detrimental to development though the specific mechanisms underlying this surprising finding were distinct for each group.

(6) Temperament

There were no group differences in the maternal rating of temperament. However SFD infants were rated on individual dimensions as more withdrawing, more intense, and having lower thresholds than preterm infants, and preterm infants had higher thresholds than both fullterm and SFD infants. Overall, when asked to rate their infants specifically as difficult, average, or easy, mothers tended to give optimal ratings in comparison with the RITQ scores.

Maternal perception in the neonatal period (as measured by the NPI) was negatively related to the mood dimension of temperament for the total sample. Otherwise relationships between NPI and temperament dimensions were few, and different for each infant group. In particular, persistence was negatively related to maternal perception in the SFD group, but positively in the fullterm group.

Sleep state stability showed a surprisingly strong relationship with temperament for the preterm group, difficult temperament being positively correlated with stable sleeping patterns. Few relationships existed for the other two groups.

Correlations between temperament and ten-month MDI scores were positive for the two at risk groups i.e. infants perceived as difficult at six months scored highly on the ten-month MDI. For the total sample arrhythmia was positively related to development at ten months.

The relationships between concurrent infant and maternal behaviour and temperament were quite different in each group. Fullterm mothers were more affectionate to infants rated difficult, who in turn were more often in W/A and les often in Q/A. Difficult preterm infants, conversely, were more often in Q/A. SFD mothers of infants rated as difficult talked and signalled alone more than those whose infants were rated as easy. The differential pattern of relationships again underscores the specificity of influence and perception.

(7) Neonatal Perception Inventory (NPI)

As the study progressed, relationships between maternal perception of the infant at one month and later aspects of development were noted in the appropriate sections. A brief summary of other findings with regard to the NPI is presented here.

In order to perform correlations with other variables, the NPI ratings were converted to positive values from one to fifteen, although in the original scale a negative rating was regarded as indicative of an infant at risk of later emotional dysfunction (see Broussard *et al*, Broussard 1980).

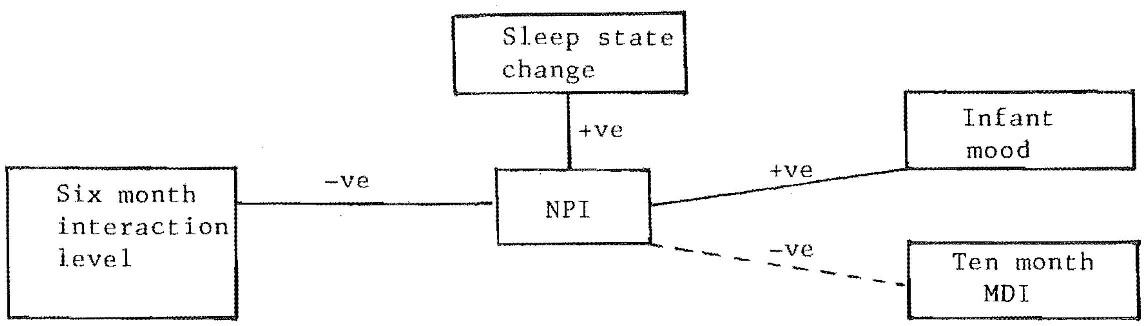
In the total sample eight (23.5 percent) of the subjects were rated negatively; one fullterm, five preterm, and two SFD infants. Thirty percent of males and 15% of females were negatively perceived.

Using the converted scale, group means were fullterm $\overline{X}$ = 10.9; preterm $\overline{X}$ = 8.9; SFD $\overline{X}$ = 10.5. The preterm group was significantly lower than the fullterm group ($t = 1.666$ $p = .2$ two-tailed t-test).

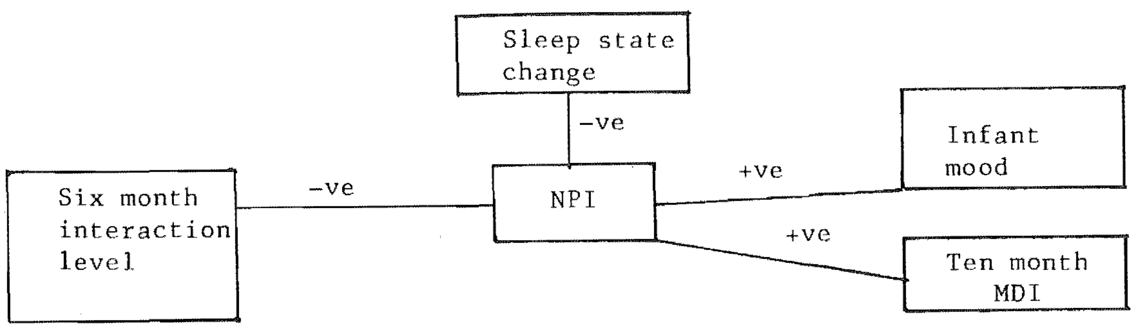
There were no relationships between NPI scores and Apgar ratings or four-month MDI scores. There were no sex differences using the converted scores. In the preterm group there were no relationships between NPI and gestational age or birthweight.

Other relationships with NPI scores are included in the appropriate sections. Because of the positive relationship for the preterm group between NPI scores and ten-month MDI scores, correlations were performed with the interaction variables shown in Chapter VI to be related to MDI performance for each group. These are displayed in Appendix 4. Neonatal perception correlated negatively with four of the maternal stimulation and dyadic interaction variables which were adversely related to ten-month MDI in preterm infants, and positively with maternal quiescence which was positively related to ten-month development. The three significant correlations in the fullterm group were the inverse of the relationships those variables had with ten-month MDI scores, suggesting a weakly negative relationship between maternal perception and ten-month development for these infants. There were no significant correlations for the SFD group.

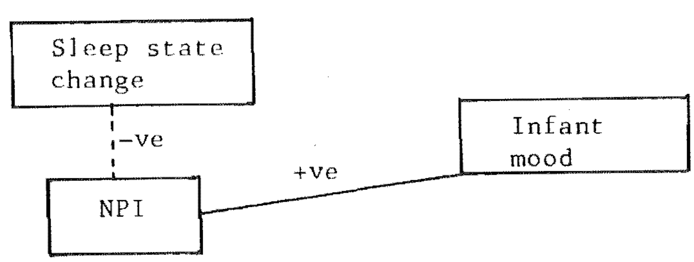
Figure I depicts the interrelationships of the NPI for each group. The infants for whom the NPI had least impact were the SFD group in which only infant mood had a significant relationship. Positive neonatal infant perception had a negative relationship with six-month interaction levels for the preterm and fullterm infants; one can speculate that infants perceived as having difficulty with sleeping, eating, and routine might be the recipients of high levels of attention. However the connection between six-month interaction levels and ten-month MDI scores was the opposite for these groups,



Fullterm group



Preterm group



SFD group

FIGURE I : THE INTERRELATIONSHIPS OF THE NPI WITH OTHER MEASURES FOR EACH INFANT GROUP and so was that between NPI and MDI scores; positive maternal perception was positively related to ten-month development for preterm infants, and tended to be negatively so for fullterm infants.

(8) Group Overview

From these results it is possible to provide a brief description of development for each kind of infant within the limits of the observations and assessments made. Figures J, K, and L illustrate the processes.

(a) Fullterm Dyads Influences on the development of fullterm infants were even throughout the first few months. Rates of neonatal sleep state change, socio-economic status, and several infant based and maternally based interaction factors at two and three months were all related to ten-month development. Four-month MDI scores and six-month interaction variables also contributed to developmental status at this age. A notable feature of this group was the lack of consistency between three and six months of all measured aspects of interaction, suggesting that the optimal development of early mother-infant relationships is flexible.

(b) Preterm Dyads Development in the first year was inconsistent for preterm infants; there was no relationship between four month and ten-month MDI scores. Several early factors, notably rate of sleep, state change, maternal perception, socioeconomic status, and maternal stimulation were predictive of ten-month development but some were in the opposite relationship to those found in the fullterm subjects. Maternal stimulation at

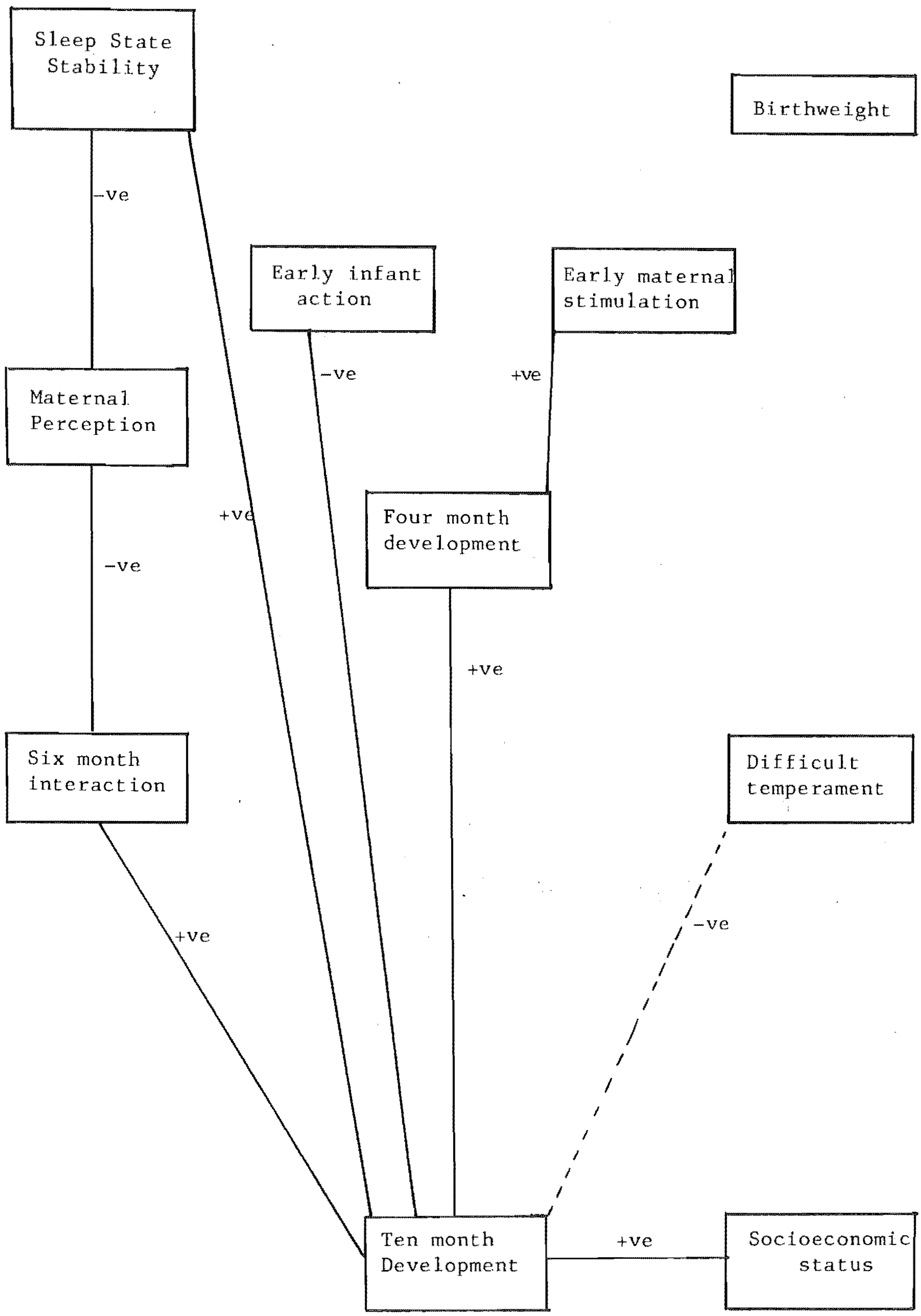


FIGURE J : MODEL OF OVERALL PATTERN OF DEVELOPMENT: FULLTERM GROUP

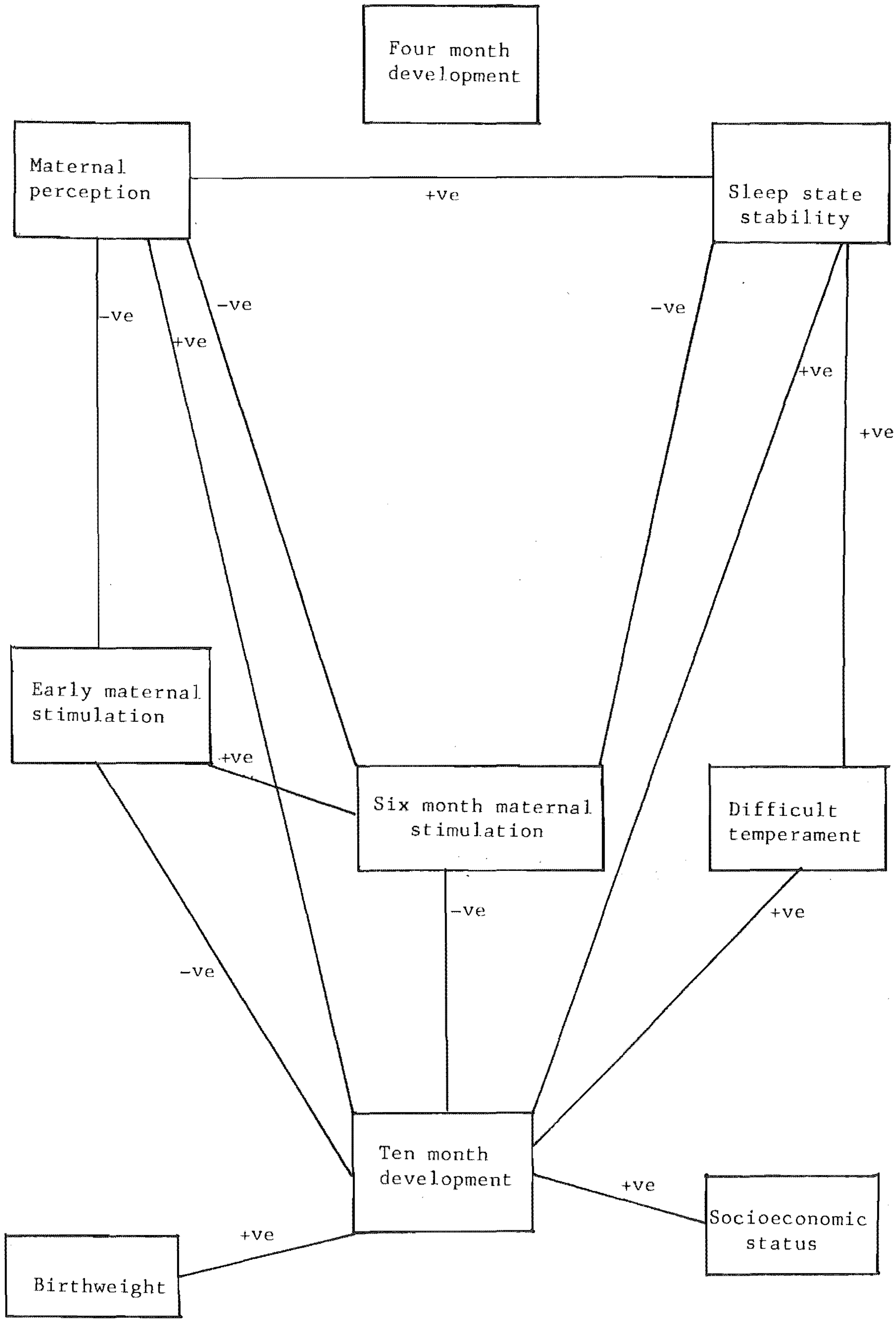


FIGURE K : MODEL OF OVERALL PATTERN OF DEVELOPMENT: PRETERM GROUP

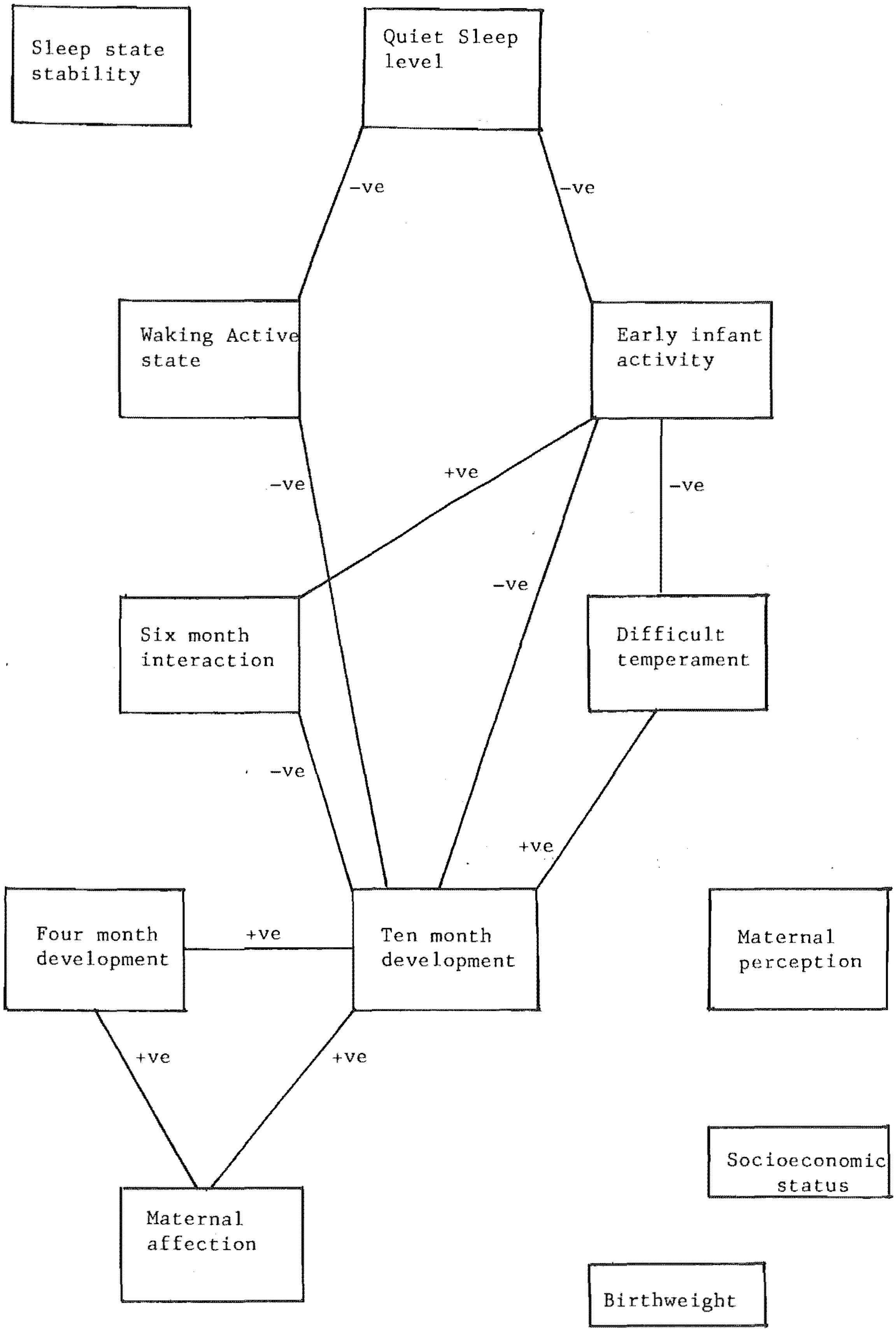


FIGURE L : MODEL OF OVERALL PATTERN OF DEVELOPMENT: SMALL-FOR-DATES GROUP three months was negatively related to ten-month MDI in the preterm group and positively in the fullterm group, and maternal perception had a positive relationship with development in the preterm infants but tended toward a negative one in the fullterm infants. Maternal stimulation at six months was also negatively related to ten-month development, whereas for the fullterm group it was positive.

Preterm dyads showed little consistency in behaviour from two to three months, but from three to six months dyadic interaction was inflexible in comparison with fullterm dyads. Preterm sleep states too were unstable at 40 weeks compared with fullterm infants.

(c) SFD Dyads Development was consistent for this group from four to ten months; however the influences upon it were distinct from those for the other two groups. In particular none of the early factors such as rate of sleep state change, maternal perception, socioeconomic status and maternal stimulation had any salience for later development. However a striking number of variables reflecting infant activity at two and three months were negatively related to ten-month development.

At six months, dyadic interaction was in inverse relationship to development. Taken with the effect of the earlier infant variables, there is a clear impression that infant inaction and passivity was optimal for these children.

Two other features were outstanding for the SFD group. The first is that they showed remarkably high consistency in interaction variables from two to three and three to six months. This, taken with the strong effects of early infant variables, indicates comparatively early mutual adaptation of the dyads in contrast to the flexibility of the fullterm group.

The second feature is that they are the only group in which infant temperament had a strong connection with development and with early state and interaction variables. Difficult temperament in these infants at six months was positively correlated with ten-month development. Furthermore (Figure H), early infant variables which were positively but insignificantly related to ten-month development, were positively related to difficult temperament ratings, specifically rate of state change, fuss, fuss/cry, and MIB alone, all of which pose potential difficulties for interaction. Hence high levels of interaction appeared to be inimicable with ten-month development, as it was for preterm infants. However the onus was very much on the SFD infant, whereas in the preterm group it was the mother whose attempts at stimulation seemed to be problematic. The patterns of development for these infants were manifestly different.

II THE IMPLICATIONS OF INFANT STATE

A theme central to this study has been the importance of infant state. Although the concept is still somewhat ambiguous its operational consequences are illustrated in several ways in the findings reported here.

(1) Sleep States

State has been viewed in two senses. First, it is seen as the behavioural expression of underlying neuor-physiological organisation, and this view is vindicated by the clear finding that the measure of sleep state change at term distinguishes both kinds of infants who can be presumed to be suffering some kind of physiological disorganisation. That sleep instability is not a function of *ex utero* environmental impact (in the case of the preterm infants) is demonstrated by the fact that instability was even more evident in fullterm but small-for-dates infants.

The second sense of the use of state has been the impact that specific states and state organisation might have both on the developing mother-infant interaction, and on the overall development of the infant. It is remarkable to note that the measure of sleep state stability was predictive of ten-month development for fullterm and preterm, but not SFD infants; however the paths of influence for the first two groups was somewhat different, as shown by the differential effects of sleep state stability on maternal perception of her infant in the neonatal period. Figure M demonstrates the mechanisms for fullterm and preterm dyads.

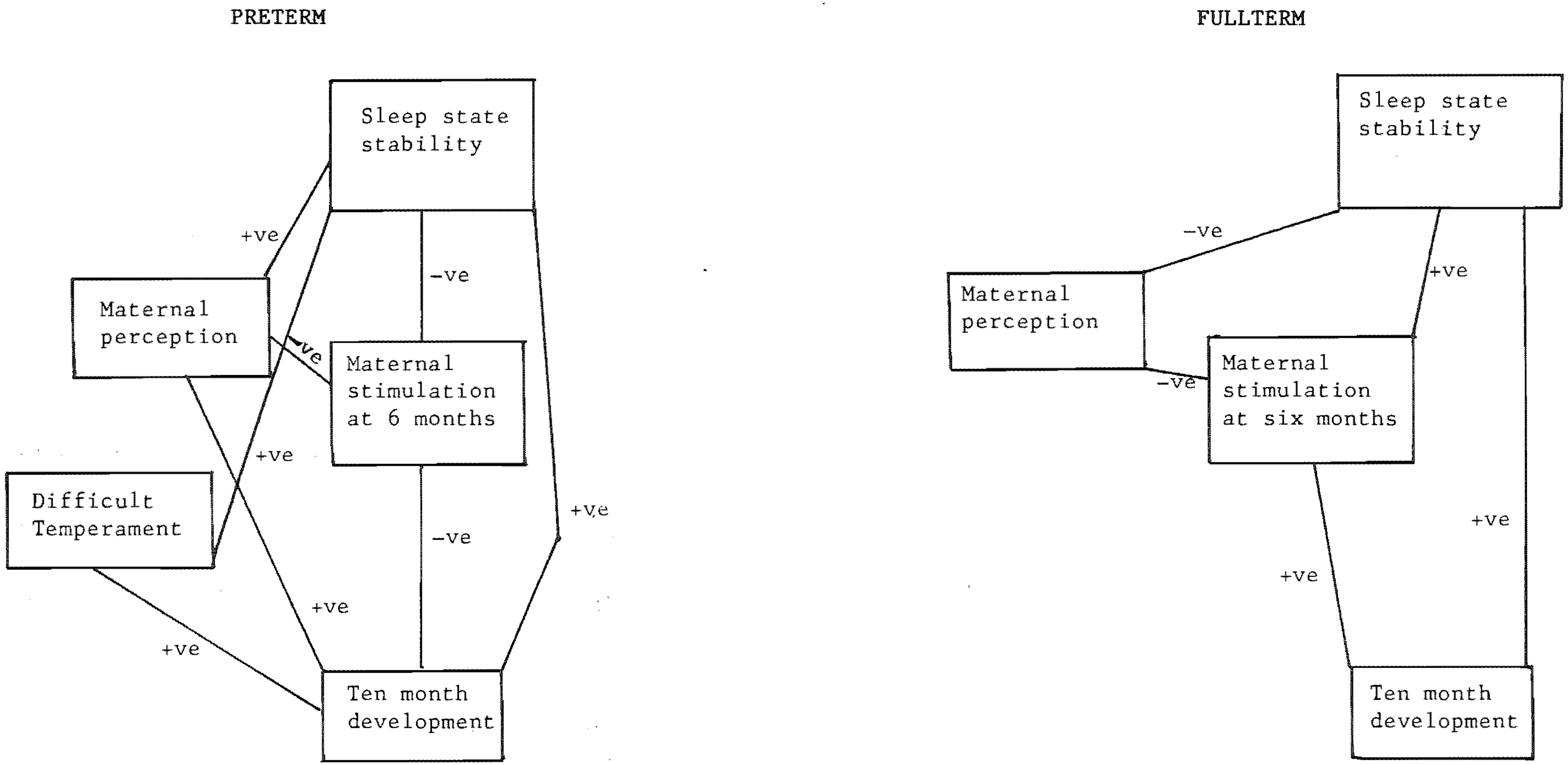


FIGURE M : DIFFERENTIAL PATHS OF INFLUENCE FROM SLEEP STATE STABILITY TO TEN MONTH DEVELOPMENT: PRETERM AND FULLTERM GROUPS

Bearing in mind that causality is not deducible from correlations, it is apparent that competent preterm infants were stimulated less at six months, perceived more optimally at one month, had more difficult temperaments, and were more stable in their sleep state organisation than their less competent counterparts whereas competent fullterm infants were stimulated more at six months and were more stable in their sleep states, and maternal perception and temperament did not have a direct relationship with development. There is no ready explanation for the fact that sleep stable infants were perceived differently in each group.

One can speculate that preterm mothers saw frequent behaviour changes in sleep as further evidence of their infants' vulnerability, whereas fullterm mothers viewed variation in sleep as signs of infant vigour. However positive maternal perception in both groups was related to lower stimulation levels at six months, and it may be that a mother's negative perception encouraged her to greater efforts at engaging her infant - again with differential effects on development at ten months.

There were no correlations between sleep state stability and waking state stability at two, three, or six months. The effect of sleep state organisation persisted, therefore, both directly and indirectly. It is likely that neurophysiological organisation would have a continuing and direct effect on later developmental status, but clearly it is also mediated by maternal perception and behaviour.

The SFD group presented a somewhat enigmatic pattern of sleep state variables. The most startling finding apart from the significant instability of sleep organisation for these infants was the high level of active sleep without REM. Becker et al noted a negative relationship between the waking state of waking active, which they described as undifferentiated since it is unfocussed activity, and a measure of state consistency derived over five weeks in the neonatal period. Active sleep without REM has been described in this study as "wasted" sleep in that it does not have the mature aspect of quiet sleep nor the proposed functional properties of REM sleep. It was decided therefore to explore the possibility that it is related to sleep state stability. Group correlations between active sleep without REM and sleep state stability at 40 weeks were as follows:

Fullterm:	$r = -.8340$	$p = .01$	$(n = 10)$
Preterm:	$r = -.8224$	$p = .001$	$(n = 14)$
SFD:	$r = -.5803$	$p = .1$	$(n = 10)$

The correlation for the total group between active sleep without REM and sleep state stability was $r = -.7428$ $p = .001$ (all using two-tailed tests of significance). As might be expected REM sleep was positively related to sleep state stability for the total sample ($r = .4644$ $p = .01$), since in each observation levels of quiet sleep were similar, and active sleep without REM and REM levels varied inversely. The relationship between REM sleep and state stability did not exist for the SFD infants, however. Quiet sleep levels were not related systematically to sleep state stability in the fullterm and preterm groups, but in the SFD group quiet sleep was positively correlated with sleep state stability ($r = .6392$ $p = .05$).

Becker _et al_ suggested that the waking active state, because of its relationship with state consistency, reflects overall state control. The same claim might be made here for active sleep without REM, since it is so strongly related to sleep state stability. However the implications of this for the SFD infants are quite different from those for the fullterm and preterm infants since sleep state stability appears not to be related to any later measures in the SFD group.

Active sleep without REM had the following correlations with developmental scores at ten months:

Fullterm group:	$r = -.1045$
Preterm group:	$r = .1373$
SFD group:	$r = .4268$

There was thus no predictive power in this state, though the small numbers in the SFD group may have precluded a significantly positive correlation. The relationship between quiet sleep and sleep state change in SFD infants suggests a potential role for quiet sleep in predicting later development, and quiet sleep was related to two-month state change (r = .6037 p = .1), three-month state change (r = .5375), and two-month waking active state (r = -.7373 p = .05), all of which predicted ten-month development. There was no relationship though between quiet sleep and ten-month development, and a negative one with four-month development (r =.5809). This lack of relationship with ten-month development is strange in view of the correlation of quiet sleep with other state variables predictive of development; it may be that with small group numbers one or two extreme levels affected the correlation. Certainly the other relationships point to quiet sleep as being an important state for SFD infants. It seemed to be a characteristic of the SFD group that sleeping periods were brief, and observations were not completed for some subjects in this group. Small numbers made analysis difficult; nevertheless it is obvious that disorganisation of sleep states for these infants does not have the same meaning as it does for their fullterm and preterm counterparts.

Sleep state stability then, was predictive of development in fullterm and preterm infants whereas there is some suggestion that levels of quiet sleep might be so for SFD infants. Sleep state stability clearly differentiates fullterm normal weight infants from the others. Levels of active sleep without REM were high for the SFD group, and this state was found to correlate highly with sleep state instability, implicating it in a role as a measure of neurophysiological organisation at least for preterm and fullterm infants. However it failed to predict ten-month development.

(2) Waking States

Waking state change is perhaps more salient for SFD infants. Correlations did not reach significance, but rates of state change at two and three months were moderately positively correlated with ten-month development in contrast with no relationship among these variables for the preterm and fullterm infants (see Table 31). A positive correlation for state change appears odd since the assumption is that high rates of state change reflect neurophysiological disorganisation; but the two-month rate of state change was strongly correlated with difficult temperament ($r = .7393$ $p = .02$ two-tailed test) which, in turn, predicted high scores on the ten-month MDI. (These relationships did not exist for the other two groups).

An exploration of the role of waking active state illuminates these relationships. Becker *et al* noted that the walking active state reflected state inconsistency which, in turn, was predictive of later dysfunction. Correlations between levels of waking active state and rates of state change in this study was shown in Table 44. The results show that there is a dramatically different relationship between waking active state, and Becker *et al*'s consistency measure and rates of state change in this study. High levels of waking active are correlated with low levels of state change i.e. state stability. This is in contrast to the relationship between active sleep without REM and sleep state stability. It is unlikely that

TABLE 44
PEARSON PRODUCT - MOMENT CORRELATIONS BETWEEN WAKING ACTIVE STATE AND RATES OF STATE CHANGE AT TWO, THREE, AND SIX MONTHS (TWO TAILED TESTS).

AGE	FULLTERM n=10	PRETERM n=14	SFD n=10	TOTAL SAMPLE
2 months	-.9085****	-.6770***	-.8808****	-.8117****
3 months	-.5696*	-.5108*	-.3608	-.5479***
6 months	-.8642***	-.7580***	-.7054**	-.7786****

*p=.1
**p=.05
***p=.01
****p=.001

the states observed are different in the two studies since state definitions here were based on those of Becker and her colleagues. It is probable that active sleep without REM is an undifferentiated state; hence its reflection of state instability. However these results imply first that waking state stability cannot be assumed to mirror the same processes as sleep state stability, particularly since there was no relationship between sleep and waking state stability; and second that state stability and state consistency are reflecting not just different, but perhaps contradictory aspects of state organisation.

This leads to a partial reapprasial of the implications of waking state change. At the beginning of the study there was an assumption that sleep state change would parallel levels of waking state change, and that both could be seen as a measure of physiological organisation at least in the neonatal period. It is possible that waking state change is also a reflection of the adaptability of the SFD infant, of the ability to modulate states according to environmental conditions.

Rates of state change were highly consistent in all groups from two to three months (see Table 15). However only for the preterm group were they consistent from three to six months. It has been suggested earlier that consistency of interaction variables might reflect lack of flexibility in dyads in the early process of mutual adaptation; it has also been noted that influences on preterm development seem to be more potent at six months than at three months. It is possible, then, that continuing consistency of state change levels in these infants indicates the later achievement of infant control over state organisation and that individual levels of state change remained inflexible because they were still more physiologically determined than susceptible to environmental influence. This exploration accords with the hypothesised consequences for preterm infants of Samaroff's formulation of necessary engagement of the milieu on page 55. Levels of interaction for preterm dyads were comparatively high at six months; perhaps this intense interaction (which took place earlier in the fullterm dyads) was necessary for the achievement of full infant control, and therefore flexibility, of state change, and in this sense would be seen as compensating for earlier low levels of social modulation.

This does not, though, explain the flexibility but high group levels state change in SFD infants. Comparatively high levels of interaction at two months (Figure B) might have facilitated infant regulation of state change and hence flexibility by six months. Figure B also shows that at all three ages SFD infants had comparatively low levels of waking active state which was inversely related to rates of state change, whereas preterm infants had this balance (low waking active and high state change) only at two and three months.

This account involves two dimensions of state change. One is infant control or modulation of states, and it is suggested that mutual interaction facilitates this control, earlier for fullterm and SFD infants than for preterm infants because of the low levels of early interaction in preterm dyads; thus state change levels continued to be consistent, or inflexible to six months for preterm infants. Both preterm and fullterm infants were vulnerable to maternal differentiation of waking active and quiet alert state at two months, and in the preterm group at three months (Table 31). This was not the case for the SFD infants, and paradoxically, maternal differentiation of states and infant differentiation of states in looking at the observer and looking at the mother at six months, were negatively related to development in these infants (Table 32). One possible explanation for this may lie in a model of expanding infant organisation by Als (1978). State differentiation and modulated control is seen as a task of the neonatal period and very early infancy; it may be that in these infants delayed aspects of state differentiation were factors in suboptimal intellectual performance. It is not obvious though why this was not so for the other infant groups.

The second dimension of rate of state change, which seems to be exclusive to the SFD group, is perhaps organically based and involves overall levels which relate to waking active levels and developmental status.

Neither rates of waking state change nor waking active state are predicted ten-month development in the fullterm and preterm infants. However for the SFD group waking active levels at two and three months were negatively correlated with later development. The relationships among waking active state, rates of state change, temperament and development are illustrated in Figure N. Waking active was negatively related to ten-month development, but also to levels of state change and difficult temperament, both of which had a positive correlation with development. It may be that levels of waking active state have, for the SFD infants, a direct relationship with development and this would support the suggestion of its role in reflecting neurophysiological organisation, though this is not apparently so for preterm and fullterm infants. The role of state change is not clear; its relationship with development is only modest, whereas waking active state and ten-month development were strongly negatively correlated at two and three (but not six) months (see Table 31).

The lack of consistency for state change levels from three to six months indicates, from the explanation given for the preterm group, a degree of success in achieving infant influence over state organisation. The continuing high levels of state change, though, suggest that although the SFD infants might have engaged their internal milieu they had not yet succeeded in taming it; their comparative invulnerability to their social environ-

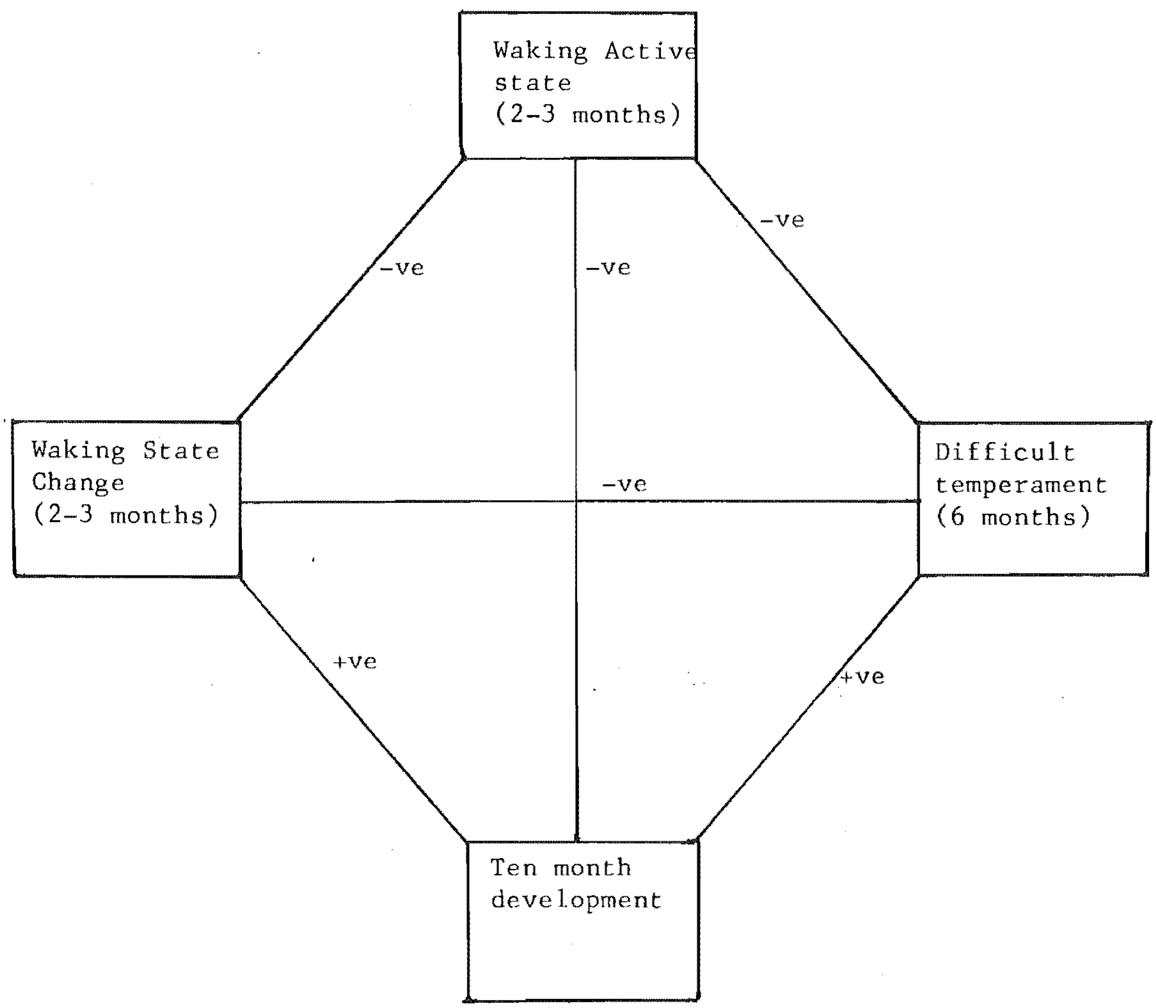


FIGURE N : RELATIONSHIPS AMONG WAKING STATE VARIABLES, TEMPERAMENT, AND DEVELOPMENT IN SFD INFANTS ment had perhaps precluded assistance from, for example, maternal state differentiation. Perceived temperament was also a mediating variable for SFD infants, between early levels of waking active state and ten-month development, with high levels being part of the perception of easy temperament. A more detailed discussion of the role of temperament is given below.

In summary, it is apparent that sleep state stability and waking state stability are not reflecting the same aspects of neurophysical or behavioural organisation. Levels were not correlated in the same infants, and they stood in contradictory relationships to states which are functionally undifferentiated. I.e. sleep state stability was negatively related to active sleep without REM, and waking state stability was positively related to waking active state.

There are clear differences among kinds of infants in the salience of state organisation. Development in fullterm and preterm infants was predicted by sleep state stability, and early maternal differentiation of waking states was also linked with development.

With the possible exception of quiet sleep, sleeping states were not related to later development in SFD infants. However waking state stability, and in particular waking active state, were predictive of development, both in negative relationships with ten-month performance.

III MATERNAL PERCEPTION

The measure of maternal perception used in this study is based on a comparison of a few specific aspects of neonatal behaviour in an "average" infant with those of the mother's own infant. Broussard (1980) points out that her research has not established the basis for maternal perception as measured by the NPI, although she suggests that expectations might become a self-fulfilling prophecy, since all infants in her investigation were considered normal by physicians.

The data here indicates that neonatal perception was anchored at least in part in infant characteristics. Sleep state stability was correlated with NPI scores, although inversely, for preterm and fullterm dyads. For both groups furthermore, positive neonatal perception predicted lowered levels of maternal activity in interaction at six months. It would seem that in these groups and in this culture an early adverse perception of an infant persisted as high levels of maternal stimulation six months later, which in the preterm infants were adversely linked with optimal development. It is not possible to determine whether the competence of the infant affected maternal levels of stimulation and maternal perception, or whether early perception and maternal stimulation affected cognitive performance. The lack of relationship between four and ten-month developmental scores supports the second suggestion, with favourable maternal perception causing the mother to allow the infant time and space in interaction, and negative perception giving rise to anxiety and insensitive over-stimulation. 35.7 percent of preterm mothers viewed their infants negatively in comparison with ten percent of fullterm mothers. This accords with the finding of high levels of maternal stimulation in the preterm group at six months.

These data do not support Broussard's suggestion that maternal neonatal perception is a self-fulfilling prophecy; they do though give considerable support to the power of early perception of an infant in predicting later maternal behaviour and infant development in fullterm and preterm infants. There was no effective measure of social and emotional development in this study; the Flint Infant Security Scale which was administered at twelve months was flawed in several ways (see Appendix 5) and showed no relationships with maternal perception. However it is likely that early maternal perception does represent an amalgamation of infant and maternal factors which have a complex but considerable effect on both emotional and intellectual outcome in the first year.

It is again quite remarkable that in the SFD group maternal perception bore no relationships to any other measured factors. One explanation would be that this is a chance finding because of small numbers, and this possibility cannot be discounted. The demonstrated lack of relationships though for both sleep state stability and SES in this group suggest that other explanations are possible.

An overall impression of SFD infants has emerged from this study that they are comparatively impervious to environmental impact in the early months. The majority of variables related to development are infant-based, there is inflexibility in both infant and maternal behaviour from two months onward, and development is unrelated to socioeconomic status (in comparison with fullterm and preterm dyads). It fits this pattern therefore that maternal perception, and any subtleties of behaviour associated with it, bear no relationship to later outcome as far as it is measured in this study.

It is harder though to explain the apparent lack of basis for the mothers' perceptions of their SFD infants. The correlation between birthweight and NPI scores is .4024, which casts doubt on infant size having a significant effect on perception. There was however a significant correlation between levels of total REM sleep at 40 weeks and NPI scores ($r = .7130$ $p = .05$ two-tailed test). The corresponding correlation for the preterm group was $r = .4189$, and for the fullterm group $r = .2382$. There is no apparent rason for this relationship, especially as total REM levels were unrelated to other sleep parameters and to MDI scores.

There were thus no measured neonatal or early interaction factors which had an effect on maternal perception in SFD dyads, apart from REM sleep levels. The apparent lack of relevance of maternal perception for development in the first year underscores the special nature of developmental processes in these infants.

IV PATTERNS OF INTERACTION

(1) Fullterm Group

The main function of the fullterm group was to serve as a control for comparison with the at-risk groups. This implies an assumption that parameters of behaviour and interaction in this group are "normal"; an assumption that is unavoidable but not necessarily justified with small numbers.

A clear finding in contrast with other dyads is the lack of consistency of interactive variables across time especially from three to six months, and this is taken to demonstrate flexibility of early interactive behaviour which allows mutual adaptation between mother and child in the first six months. The ability of both partners to adjust their levels of behaviour in relation to each other is particularly salient in regard to the developmental changes that take place, from the emphasis on early social interchange as a basis of communication to the increasing importance of the object world for infant cognitive development. It is not surprising, therefore, that levels of interaction which were consistent from two to three months were entirely inconsistent from three to six months as mother and infant took less interest in direct interaction.

Paralleling the evidence from consistency correlations, Tables 9 and 10 indicate that levels of infant looking, smiling and vocalising increased from two to three months in this group and irritability decreased. From three to six months infant looking and smiling decreased, although vocalising increased (Table 24). Corresponding increases in maternal vocalising and looking took place from two to three months, and decreases in the same signals from three to six months (Tables 11, 12 and 25). Interaction variables reflect the same pattern (Tables 13, 14 and 26) with overall mutual interaction (SIB) considerably lower at six than at two months.

The normal course of interaction levels in the first six months therefore was one of increasing involvement to three months, and decreased mutual involvement by six months. Broad support for the optimality of this pattern is found in the report of Siegel who noted in a study of fullterm and preterm children that if developmental delay was incorrectly detected at four months, maternal responsiveness was a significant factor in effecting normal development. Incorrect detection of developmental delay at twelve months though was mediated by the provision of toys and play materials. Hence in the early months interactive factors were important, but later the physical environment was more significant for development.

The relationships among interactive factors and development in fullterm infants in this study are somewhat confusing. High levels of maternal and infant signals, and dyadic interaction and synchrony, are features of competent infants at four months. Some of these variables though are not related or tend to be in inverse relationship to ten-month infant development. Interaction levels, mutual gaze, and dyadic synchrony at two and three months, for example, are not related to later (ten month) competence. These findings strongly illustrate the point made by Coates et al, that aspects of interaction may affect development in different ways, and may be salient at one level but not another. Furthermore, a parameter of interaction at two or three months may be related to ten-month intellectual performance but at six months be apparently irrelevant. For example, maternal differentiation of states at two but not six months was predictive of competence at ten months in this study.

The relationships among interaction factors and development are clearly complex even for normal infants. The patterns here appear to correspond to those found by Coates et al as far as comparison of different observation stages will allow, and further analyses of these data might uncover other similarities with regard to the effects of distal and proximal stimulation, for example. However the main focus of this study is comparison of different kinds of infant in interaction.

(2) Preterm Group

When preterm and fullterm mother-infant dyads were compared using a chronological-age comparison at three months (Table 22) a balance of interaction was found which was similar to the consensus of findings from other studies (Field 1977, Field 1981, Field 1982, Crnic, Ragozin, et al, Goldberg, Crawford, Brown and Bakeman). Preterm infants were typically unresponsive, and preterm mothers were zealous but comparatively unsuccessful in their attempts to interact in a synchronised way with their infants. A corrected age comparison however (Table 14) shows the reverse situation. Whereas preterm infants were signalling at the same level as fullterm infants, preterm mothers had lowered their levels of stimulation, in some cases dramatically, from two to three months (corrected ages). Field and Crnic et al used corrected ages in their studies, so there is a contradiction in findings between their results and these which might be explained, as suggested earlier, by cultural differences in the mothers' responses to passive infants.

Another explanation though is suggested by the finding in this study that maternal perception in the first month was related to lower levels of maternal stimulation. Many (in some cases all) the infants in the studies by Field, Crnic et al, Crawford and Goldberg were ill in the neonatal period, and it is likely that maternal perceptions of these infants would be low, perhaps resulting in later high levels of maternal activity in interaction. None of the preterm infants in the present study was ill so maternal perception is likely to have been comparatively high. So the drop in levels of maternal activity from two to three months is more likely to reflect a culturally based response to low infant activity levels at two months, than a link with neonatal perception. Brown et al's results showed the familiar pattern of maternal activity - infant passivity at three months in healthy preterm subjects; cultural differences between black, low SES mothers in USA and white, middle class mothers in New Zealand are likely explanations for the contradictory findings between this study and that of Brown et al. There is also an important difference in observation situations. Brown et al (and many other investigators) observed interactions in a clinic room, where it is very likely that mothers would feel some pressure upon them and their infants to "perform". In the present study observations were carried out in the home over a range of activities, by observers who were familiar to the mother and who had spent time in informal conversation on previous occasions. It is less likely that in this context a mother would feel obliged to interact at levels unnatural for her.

Maternal stimulation of preterm infants therefore, oscillated from high, low, to normal at two, three and six months in comparison with fullterm mothers (Figure A). The combination with infant parameters produced levels of interaction that were low at two and three months and high at six months, levels that were not optimal for development at those specific stages. It is obvious that it is not easy for preterm mothers, even those whose infants were never ill, to co-ordinate their signals with those of their infants. Unresponsive infants at two months seemed to have the effect of dampening the mothers' efforts at three months, and overcompensation by the infant in particular at six months led to an absorption in mutual interaction. The study by Barnard et al, which investigated the developmental course of preterm and fullterm infants in the first two years, showed that at eight months preterm infants were more involved than fullterm infants in teaching tasks with their mothers. The preterm mothers in turn maintained stable or declining involvement with their infants. This balance of contribution to the interaction is rather similar to the findings at six months here, although based on a teaching task observation rather than day-to-day activity.

Another point noted by Barnard et al is the less affective involvement of preterm mothers with their infants. This study also recorded low levels of affectionate behaviour at three and six months by preterm mothers, and overall, despite differences in timing and style of observations, this study and that of Barnard et al concur in uncovering different patterns of development of interaction in preterm and fullterm dyads; patterns which furthermore have differential implications for intellectual functioning. In particular, levels of interaction which were appropriate at six months for fullterm development were inappropriate with preterm development. Table 32 indicates that direct maternal signals and mutual interaction at six months were not conducive to development for these infants, but maternal quiescence and attention to infant play, and infant vocalising and smiling, were. This suggests an optimal combination at six months of infant attention to the physical environment, with maternal encouragement and lack of direct stimulation, and contrasts strongly with the ability of fullterm infants to benefit from direct maternal stimulation and responsiveness. Table 33 high-lights the factors which affected development differentially for the two groups, and provides an intriguing picture of the limits of stimulation which are in place for preterm infants. Maternal activities which are considered normal and beneficial to infant development appear to overload the preterm infant's ability to process information, and the work by Rose _et al_ (1982) demonstrating their reduced ability to cope with visual cues in the first year, adds credence to this finding. The preterm mothers were thus faced with the intricate task of modulating their agency with their infants in order to encourage infant activity without overwhelming infant processing capacities. The contrast between the positive effect of maternal quiescence and the negative effect of infant quiescence on ten-month development underscores the difficulty faced in doing this.

(3) Small-for-Dates Group

The chronological age comparison for interactive variables at three months (Table 22) shows a difference between preterm and SFD infants which was central to their overall comparison. Although the balance of infant passivity and maternal activity in the preterm dyads was the same as the preterm-fullterm comparison, preterm infants had higher interaction ratios than SFD infants. When they did signal, it was more likely to be in the same epoch as a maternal signal. This specific lack of co-ordination of signalling was reflected more generally in this group at two and three months by comparatively high levels of infant signalling, more drowsing, fussing and crying than both preterm and fullterm infants, and lower synchrony indices. In this regard Als et al (1979) noted for SFD infants

> "difficulties reflected in reflex behavior as well as in state (state of consciousness) control of their central nervous system responses, in the infant's capacity to shut out disturbing stimuli and respond appropriately to social stimuli."p 174

Als et al were reporting on neonatal responses; it seems clear that SFD infants have continuing difficulty in co-ordinating their signals with those of their mothers', at least until three months. By six months, levels of interaction were the same as those of the fullterm dyads (Figure B), but with a pattern of infant passivity (less infant initiation of interaction, more infant quiescence), and maternal activity (less maternal quiescence), more maternal signalling alone). So SFD infants seemed to have a change of activity levels in contrast to the preterm group, who moved from low through normal to high amounts of interactive effort. The SFD infants had initially high levels of activity but by six months were passive in comparison with fullterm and preterm infants. Their mothers maintained high or normal levels of stimulation in contrast to the fluctuations of the preterm mothers.

It is notable that this general style of interaction at six months for SFD dyads was similar to what appeared to be optimal for development at that stage (Table 32). The significant correlations present a pattern of infant inactivity and lack of dyadic interaction that was linked with later development. Infant initiation (Mother response) infant response to look, interaction levels and mutual gaze were all incompatible with ten-month MDI socres. Insignificant but positive correlations for infant play, maternal affection, maternal interaction to quiet-alert state, maternal interaction to play, and maternal signalling alone indicate a pattern of infant passivity and maternal encouragement to quietness.

Table 34 contrasts pattern of interaction related to development for fullterm and SFD dyads. Vocal and visual signals and their mutual interplay were clearly aspects of high-scoring fullterm infants whereas the absence of these and high levels of infant play characterised high performing SFD infants. Infant inactivity and maternal affection are highlighted as optimal for SFD dyads in contrast to preterm dyads in Table 35.

There is an overall impression, in these infants, of considerable effort to achieve control over their behavioural organisation, and their absorption in this at the expense of their ability to benefit from maternal stimulation. They apparently failed to elicit from their mothers the organisation they lacked, whereas preterm infants were able, at least partially, to do this. By six months they seem to have been partially successful in modulating their own behaviour, but had become somewhat passive partners in interaction.

The mothers of SFD infants were thus presented with a confusing neonate who was active and yet drowsy, whose signals were unco-ordinated, and who by six months was somewhat withdrawn. The contrast with the preterm infant is considerable.

V THE CONCEPT OF TEMPERAMENT

The pattern of results surrounding the maternal rating of infant temperament in this study does not support the viw of infant temperament as an unchanging individual attribute. The results also invite caution in considering temperament as a stable social-perceptive phenomenon, for several reasons.

The question of whether or not the maternal report is an objective assessment of infant temperament is partially answered in the finding, here and in other studies, that mothers' global ratings of temperament dimensions differed from scores on the temperament questionnaire. This supports a degree of objectivity in the format which probes behaviour in specific situations.

However serious doubt is cast on the implications of the resulting temperament profile by the absence of and/or conflict in findings of corresponding differences in observed infant behaviour. In this study for example, concurrent infant state and earlier infant smiling was related to temperament ratings, but inversely in each case for preterm and fullterm infants. So a difficult preterm infant smiled less at two months and was less often in waking active state at six months, whereas a difficult fullterm infant smiled more at three months and was more often in waking active state at six months. If infant difficulty was a specific perception elicited from mothers then one might base an explanation of this discrepancy on maternal expectations of fullterm and preterm infants. But infant difficulty is based on ratings in concrete situations and it is plausible to suggest that the fact of being preterm causes an infant who is, say, more adaptable and rhythmic and approaching to smile more while the fact of being fullterm has the opposite effect.

Further doubt is cast on the objectivity of maternal ratings by the finding here that SFD infants demonstrated no links between concurrent behaviour and temperamental style.

The possibility that temperament ratings represent a stable maternal perception of the infant is tested by considering the relationships between temperament and maternal behaviour. If mothers perceive their infants as difficult, for example, it is likely that they will behave in observably different ways from mothers who perceive their infants as easy. The results of this study do not show a unified kind of maternal behaviour pattern toward a particular kind of perceived temperment. The only concurrent maternal behaviour which related to temperament ratings in the fullterm or preterm groups was maternal affection, which was high toward easy fullterm infants. In the SFD group several aspects of maternal behaviour were linked with temperament. If this finding is considered with the fact that several early infant factors predicted six-month temperament ratings, then one could postulate a cumulative process for the effect of infant temperament on maternal behaviour, although infant differences had disappeared by six months. Nonetheless this process was not demonstrated in the other groups.

It was suggested in Chapter I that temperament might by construed as a stable social perceptive phenomenon combining infant and maternal factors in a similar manner to maternal perception of the neonate. There was, however, no significant relationship between NPI scores and total temperament scores which calls in question this suggestion. Paradoxically, in the preterm group temperament ratings stood in the same juxtaposition to sleep state stability and ten month MDI scores as neonatal perception scores (see Figure F). This hints at a constitutional component for perceived temperament in these infants.

The link between temperament ratings and ten-month development was also found for the SFD infants (Figure H), and the relationships among early infant variables and temperament were broadly the same as those among the same variables and ten-month development. It seems, then, that the factor measured here as temperament resembled intellectual functioning for the at-risk infants in its overall relationship with other measured parameters.

One explanation for this might be that offered by Roth et al (1984), who suggest that mothers of preterm infants (and presumably SFD infants) are more sensitive to nuances of behaviour than fullterm mothers because of the compromised status of their infants. An alternative suggestion is that in the fullterm dyads the effects of temperament on development are attenuated by the more even tenor of developmental processes in these infants.

Hubert et al (1982) noted, similarly to the present study the equivocal mixture of results which bear on the theoretical notions of temperament as either an organismic characteristic of the child or a perceptual-phenomenological construct reflecting (usually) parental perception and infant characteristics. Hubert et al propose an approach to measurement which utilises cues generated by parents in rating their children's temperament, with one set of cues resulting which would occur across most conditions, and another set relevant to particular parameters such as the age of the child, social class, and father versus mother judgements. The findings reported here underline the importance of incorporating cues that are specific to certain kinds of children. Clearly, for example, preterm and fullterm parents regard some infant features in quite contradictory ways, and the fact that temperament ratings based (as they are in the RITQ) on arbitrarily imposed dimensions show discrepant relationships with development suggest that parent-generated dimensions might be more pertinent to an effective construal of temperament.

The present results throw sufficient doubt on the way in which temperament is measured to suggest the need for further research and theory. The fact that parents believe their children have certain kinds of personalities is sufficient reason for pursuing the notion of temperament, even if it turns out to be entirely a perceptual phenomenon. Findings here suggest that it has, as well, some basis in the person.

VI IMPLICATIONS OF THE STUDY

(1) Differential Process of Development

Every aspect of development studied in this investigation emphasises the fact that the paths of development for fullterm, preterm, and small-for-dates infants are different. The realisation of this is beginning to emerge in research literature most clearly in the studies of preterm development (Siegel 1982, Ungerer *et al* 1983, Grigoriou-Serbanescu 1984), differential response to environmental parameters (Wachs et al 1983), and interaction studies (Field 1976, Brown et al 1980, Beckwith et al 1984). It can no longer be assumed that differences between preterm and fullterm development are simply developmental lags; there are qualitative differences which have both theoretical and practical implications. Neither can it be assumed that the effects of intrauterine growth retardation are the same in the first year as those of preterm birth; these results show dramatic differences in such parameters as state organisation, interaction patterns, temperament, and the influences of these on developmental status.

Both groups who were compromised at birth showed inflexibility of interaction style up to six months, whereas inconsistency of interaction parameters was a feature of normal development, indicating the danger of expecting continuity in specific aspects of behaviour. Inflexibility of interaction style, though, was not paralleled by developmental consistency in preterm infants, whose developmental level at four months did not predict ten-month development.

The assumption that a particular caregiving style is optimal is also cast into doubt. The received truths of mothering which are encompassed by stimulation and responsiveness are not necessarily beneficial for preterm and small-for-dates infants, and Field's view that preterm infants are easily overloaded with stimuli is amply documented here.

It is clear, furthermore, that there is a degree of cultural specificity in maternal responses to preterm infants; New Zealand mothers in this study decreased their levels of stimulation in face of an unresponsive infant. Socioeconomic effects, too, were apparent in a country which has prided itself on its egalitarian nature in the past.

This study suggests the need for further investigation into several areas of development. In particular, the role of state and state organisation invites exploration at both theoretical and practical levels. The findings here are tentative, but point to complex and differentiated roles for sleep and waking state organisation in different kinds of infants. State constructs provide a potentially powerful means of understanding infant-environment processes and possibly of environmental manipulation toward a more optimal development. At a practical level, it is clear from this study that infant state dimensions have a potent effect on mothers, though a great deal of further research is needed to elucidate the precise patterns.

Another area of particular importance is the link between interaction variables and development. Surprisingly few investigations have been carried out in this area; the work by Coates and Lewis illustrates the complexities of the differential effects of maternal stimulation on time and facets of competence in fullterm subjects. This study adds to these the crucial effect of infant neonatal status.

The investigation reported in this thesis is one of the first to consider the process of development in infants who have suffered intrauterine growth retardation. The consensus from a number of outcome studies is that the prognosis for growth retarded infants is often poorer than that for preterm infants, and that the deficits in these infants are subtle. The results reported here represent a preliminary outline of the mechanisms operating in the first year in small-for-dates infants; a great deal more research is needed to confirm and extend these findings. The apparent invulnerability of the small-for-dates infants to social influence in the first six months is discouraging, but there is suggestive evidence on what might be optimal caretaking patterns. At every stage in the study the small-for-dates group stood out from the others as being different; their inability to control their state organisation contributed to their lack of ability to elicit help in organising themselves, so that in Samaroff's terminology, they had "low value as stimulus objects" (Samaroff 1976). Other investigators, notably Neligan et al, have shown that environmental influence can be strong for these infants, even in modifying soft neurological deficits; the present study considered interactions only in the first six months and it is probable that infant sensitivity to stimulation increases thereafter.

(2) Practical Implications

The word "intervention" can carry overtones of patronisation and hierachial relationships, and there is already available for parents a plethora of books and services aimed at advising them on how to raise their children. In many cases the consensus of advice is contradictory, or describes the behaviour of a "typical" infant which often fails to match their own experience.

The focus of any effort to support and help parents should be to encourage the process of understanding and responding to the signals of their individual infants, and there are some attempts to do this through books (e.g. Brazelton 1969).

Although there must be caution both in the generalisation of findings and in the need for support in specific situations, this investigation suggests areas of behaviour differences in preterm and small-for-dates infants, the awareness of which might help their parents to interact satisfyingly with them.

(a) Preterm Infants Some sources of advice for preterm parents are already available (e.g. Goldberg and Di Vitto 1983). However more immediate and practical means might be used for supporting parents in the delicate task of finding optimal means and levels of stimulation, since it is clearly easy to overstimulate even healthy preterm infants.

An early awareness of infant states would be useful for a preterm parent, and guidance in recognising and eliciting waking states by their own efforts would be a simple and effective step. Movement of an infant from a supine position to the shoulder, for example, reliably elicits the quiet-alert state. Helping parents to stimulate and recognise visual following, and to respect an infant's need to withdraw from interaction, might add to their awareness of the capabilities and needs of their child. Multi-modal stimulation appeared to be a disadvantage for preterm infants, so the need for clarity of cues by parents might be emphasised.

The most difficult problem for preterm parents is to encourage activity and responsiveness in their typically unresponsive infants, without overstimulation. A potent way of increasing infant activity is by imitation. Infants are able to imitate adult activity from an early age, and parents typically infantise their speech in interaction by slowing and modulating their words. Direct imitation of infant action provides feedback for the child on what has just happened; it also acts as a powerful reinforcer of the activity. Thus imitation of facial and tongue movement, vocalising and body actions, elicits both delight and repetition without direct and perhaps aversive stimulation. The exhortion to "bathe your child in words" is not appropriate for preterm infants in the first few months.

At six months direct stimulation was still inimicable with development for these infants, despite their high levels of signalling. Encouragement to play by provision of materials and, importantly, playing with an infant with toys, would allow indirect stimulation and promote infant attention to objects.

A structured method of encouraging interaction between adults and infants which encompasses the three aspects of close awareness of the infant, imitation of activity and vocalisation, and involvement in play, is explicated by Mahrer, Levinson, and Fine (1976). The method involves a mother spending 30 minutes a day on the floor with her infant allowing the infant to inititate and direct activity. The mother's role is to promote the infant's effectiveness on the immediate environment by carrying forward the infant's self-initiated behaviour toward its natural effect, and this requires observation, responsiveness, and lack of directiveness on the part of the mother.

This technique was designed and is used for educational support programmes in North America (for example the Home Start Program run by Next Door Foundation in Milwaukee, Wisconsin). It has obvious relevance, too, for preterm infants and could be used as a starting point for helping parents to build gratifying relationships by removing the emphasis on direct (and directing) stimulation. It is notable that a strategy arising from a different area of psychology than this study (psychotherapy) comprises similar notions of effective interaction to those emerging from the present findings.

(b) Small-for-Dates Infants There is no precedent in popular or research literature for advising or supporting parents of small-for-dates infants. Direct interaction at six months was inimicable with later development, and in this regard a programme similar to the one described for preterm dyads which encourages infant play and indirect stimulation might be beneficial.

The strong difference between preterm and small-for-dates infants was the apparent benefit to the latter of calming techniques, in contrast to the need in preterm infants for encouragement to action. The understanding by parents of small-for-dates infants of their child's difficulties in controlling behaviour might help them both in being aware of infant signals of stress (colour changes and gaze aversion, for example), and in offering physical assistance such as hugging, stroking, and rubbing. The tentative and pioneering nature of the findings here mean that little detail can be suggested, and it would be of great interest to investigate the effectiveness of various calming techniques. There is an overall impression of the need in these infants for help in controlling and organising their behaviour before they can become satisfying interaction partners. They are perhaps the least rewarding and most confusing kinds of infants in this investigation, but understanding of their needs and problems would go along way toward making their parenting more enjoyable and rewarding.

VII DRAWBACKS OF THE STUDY

A stated aim of this study was to undertake a detailed investigation of comparatively small numbers of subjects, which meant facing a compromise over sample size. It was unfortunate that subject attrition was worse in the small-for-dates group than in the others which caused many correlations for this group to come tantalising close to, but miss, significance. A larger sample size, therefore, would have been desirable although resources of time and personnel were stretched even with this number.

In view of the results, a longer study would have enriched the findings considerably; in particular observations of mother-infant interaction in the second half of the first year would have been valuable.

A third, and important, drawback is the nature of the outcome measures. The Mental Development Index of the Bayley Scales of Infant Development was chosen because of its ubiquitous use in other studies, and because it has been shown to whave some predictive validity when combined with other measures. Grigoriou-Serbanescu (1984) makes the point that a measure of intellectual performance can be considered an assessment of the cumulation of influences to that stage. Nonetheless an adequate measure of social competence and/or emotional development would have added crucial information to the overall picture. The Flint Infant Security Scale was inadequate (see Appendix 5).

It was also beyond the scope of this study to make a systematic investigation of the wider social context of the families. Socioeconomic status is a variable which subsumes many factors including maternal education, attitudes, and behaviour, as well as potential stress such as poverty, lack of support systems, and dissonance between the ability to benefit from services and the accessibility of those services. In particular in this sample, relationships with hospital staff, Plunket nurses, and general practitioners are important to the overall support a new mother actually receives. Belsky (1983) has noted the importance of intimate social support for parenting. So although maternal attitudes and behaviour have been measured in this investigation, other factors crucial to the satisfactory outcome of children have not.

Despite the formal and impersonal language of this report, it in fact chronicles what it is like to be the mother of a small, or a premature infant. Clearly it is not always easy, and although the focus of the findings was on the effects on intellectual functioning, for the mothers the most immediate concerns were in the day to day relationships with their firstborn infants who, while not abnormal, were not normal either. My admiration for their love and persistence and courage is considerable, and it is noteworthy that some of the most stressed mothers were in the fullterm group. I suspect that many of the mothers of "compromised" infants would be surprised to hear them called that, and would be doubtful too if told that they had experienced difficulties in the first year. There is therefore an important responsibility for researchers not to generate anxiety in situations which are perceived by parents to be satisfactory. Conversely there is a responsibility to use in the most helpful way the knowledge gained from the co-operation of women like those in this study.

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APPENDIX I

CORRELATIONS BETWEEN INFANT DROWSE AND INTERACTION VARIABLES AT TWO AND THREE MONTHS (PEARSON PRODUCT-MOMENT CORRELATIONS; TWO TAILED TEST)

VARIABLE	TWO-MONTH DROWSE			THREE MONTH DROWSE		
	FT	PRETERM	SFD	FT	PRETERM	SFD
Infant Look	.0936	-.4453	.0963	-.0826	-.4705*	-.2393
Infant Voc	-.0572	.0945	-.5406	-.3101	.4182	-.3199
MIB to l/m Voc	.2277	.1868	.1747	-.1533	.0425	.2413
IIB to l/b Voc	.0433	-.3848	.0220	.0689	-.2506	-.3401
Maternal Look	.4685	.0087	.2460	-.1552	-.4841	.6342*
Maternal Voc	-.1005	.1148	-.0121	-.6470**	-.1491	.1631
SIB	.4060	-.3182	.1263	-.2272	-.4232	-.2035

*p=.1
**p=.05

APPENDIX 2

CORRELATIONS BETWEEN INFANT FUSS/CRY AND INTERACTION VARIABLES AT TWO AND THREE MONTHS (PEARSON PRODUCT-MOMENT CORRELATIONS; TWO TAILED TEST)

VARIABLE	FUSS/CRY TWO MONTHS			FUSS/CRY THREE MONTHS		
	FULLTERM	PRETERM	SFD	FULLTERM	PRETERM	SFD
Infant look	-.6037	-.1978	-.5299	.2575	-.3569	-.0487
Infant Voc	-.7831**	-.5424**	-.5087	-.1106	.0346	-.0121
MIB to l/m Voc	-.7556**	.3211	.4175	.4775	-.3121	.4698
IIB to l/b Voc	-.6785*	-.4207	-.6321*	.0874	-.2703	-.1066
Maternal Look	-.4587	-.0366	-.2022	.2340	-.3135	-.0309
Maternal Voc	-.1169	.6037**	.4283	.5207	-.0350	.0869
SIB	-.6949*	-.2115	-.1020	.6244*	-.3474	.1890

*p=.1
**p=.05

APPENDIX 3

CORRELATIONS BETWEEN FOUR MONTH MDI SCORES AND RITQ DIMENSIONS AT SIX MONTHS (TWO TAILED TESTS OF SIGNIFICANCE)

RITQ DIMENSION	FULLTERM	PRETERM	SFD
Activity	-.1548	.3749	.0075
+*Rhythmicity	.5809	-.2115	.5093
+Approach	-.2437	-.2076	.1286
+Adaptability	-.5259	-.3471	.1068
Intensity	.1261	.3703	.5337
+Mood	.1407	.4280	.2380
+Persistence	.2132	.4331	.0273
+Distractibility	.2037	-.4602	.3868
+Threshold	-.0705	-.0200	.2422

+ High scores mean low ratings on these dimensions
* r=.5111 p=.05 for SFD and Fullterm group combined.

APPENDIX 4A

CORRELATIONS BETWEEN NPI SCORES AND INTERACTION VARIABLES: FULLTERM GROUP

THREE MONTH VARIABLE	CORRELATION WITH NPI	SIX MONTH VARIABLE	CORRELATION WITH NPI
Infant Vocalise	.2961	Maternal vocalise	-.0169
Maternal Smile	-.2203	Infant vocalise	.5059
IIB m-modal	-.2775	MIB to W/A	-.5432
MIB alone	.1698	MIB to voc	-.5111
IIB to Voc	-.3881	MIB to fuss	-.7771***
		MIB alone	.0772
		IIB alone	.6368**
		IIR	-.6226*

*p= .1
**p=.05
***p=.02

APPENDIX 4B
CORRELATIONS BETWEEN NPI SCORES AND INTERACTION VARIABLES:
PRETERM GROUP

THREE MONTH VARIABLE	CORRELATION WITH NPI	SIX MONTH VARIABLE	CORRELATION WITH NPI
Infant Voc	.5698**	Maternal Look	-.3379
Maternal m-modal	-.5357**	Infant Vocalise	-.0230
MIB to Fuss	-.3241	MIB to W/A	-.5923**
Maternal Affect	.0796	MIB to look	-.5123*
		MIB to Play	..3571
		MIB to Fuss	-.5240*
		Mother Response	-.3209
		Mother Q	.6015**
		Infant Q	-.6496***
		SIB	-.5258*
		SIB excl fuss	-.4004
		SI	-.3868
		Mutual gaze	-.2473

*p=.1
**p=.05
***p=.02

APPENDIX 4C
CORRELATIONS BETWEEN NPI SCORES AND INTERACTION VARIABLES:
SFD GROUP

THREE MONTH VARIABLE	CORRELATION WITH NPI	SIX MONTH VARIABLE	CORRELATION WITH NPI
W/A	.1247	Q/A l/m l/obs diff	.5668
Infant Look	-.0817	SIB excl Fuss	-.2069
Infant Vocalise	-.2863	Mutual gaze	.1159
IIB to l/b, Voc.	.1177	MIR	.0953
SIB	-.1342	Mother Response	.0511
SIB excl Fuss	-.3240	SI	-.0905
SI	-.2552	State Change	.2075
Mutual gaze	-.0532	Play	.1207
IIB to Vocalise	.0387	Infant Look	.0391

APPENDIX 5

FLINT INFANT SECURITY SCALE

When the infants were twelve months old, the Flint Infant Security Scale (Flint 1974) was administered to mothers in the study. This short interview questionnaire was chosen on the pragmatic grounds that no other measures were available to assess aspects of social-emotional development at this age without involving observation procedures. At this point in the study time and resources were too limited to either design alternative questionnaires or undertake further observations.

The questionnaire comprises 37 items designed to assess infant security. On each item an infant can be scored as showing either secure behaviour, or the use of a deputy agent or regression as an indication of insecurity. Items are based on day-to-day activities such as eating, sleeping, and exploring new environments.

Validity for this scale was assessed on 19 infants, all of whom were in foster care. Its relevance to this sample is therefore limited both by absence of validation data in general and by probable cultural differences which put into question its usefulness in New Zealand. Results are reported here with these limitations in mind:

I RESULTS

(1) Group Differences

The mean scores for each group were as follows:

Fullterm: $\bar{X}$ = .23, SD .08

Preterm: $\bar{X}$ = .28, SD .09

SFD: $\bar{X}$ = .287; SD .06

Fullterm and SFD groups were significantly different ($t = 1.9$, $p = .1$ two-tailed t-test), and fullterm and preterm groups tended to be different ($t = 1.4$, $p = .2$ two-tailed t-test).

(2) Relationship with Development

Correlations between Flint scores and ten-month MDI scores were as follows:

Fullterm: $r = .4707$

Preterm: $r = .2384$

SFD: $r = .5215$

None of these correlations was significant.

(3) Relationship with SES

The following correlations were obtained between Flint scores and the socioeconomic status of the families:

Fullterm: $r = -.4447$

Preterm: $r = -.5826$

SFD: $r = .3858$

For the fullterm and preterm groups combined, the correlation was r = -.5494 (p = .01). The correlations for the preterm and SFD groups were significantly different (z = 2.036 p = .05).

(4) Relationships with Temperament and Maternal Perception

Correlations were as follows:

(a)	Temperament	Fullterm:	r = -.4045
		Preterm:	r = -.0166
		SFD:	r = .0474
(b)	NPI	Fullterm:	r = -.1342
		Preterm:	r = .1874
		SFD:	r = .2613

(5) Relationship with Maternal Responsiveness

Attachment theory would suggest that responsive mothering is fundamental to infant security (e.g. Ainsworth 1973). The variable in this study which most closely approximates maternal responsiveness is Mother Response; correlations between Flint scores and six-month Mother-response levels were computed, and were as follows:

Fullterm:	r = -.7393
Preterm:	r = -.2463
SFD:	r = -.4052
Total Sample:	r = -.5384 (p = .01 two-tailed t-test).

II DISCUSSION

All groups in this study scored below what the author of the Flint scale considers the lower limit of optimal mental health (.35). This discrepancy is likely to reflect cultural differences rather than disturbance in the sample. The apparently higher levels of security for the two risk groups is difficult to explain in view of the probability that mother-infant interactions are likely to be more difficult for these dyads than for the fullterm group.

The significant relationship for fullterm and preterm groups but not the SFD group between Flint scores and SES is of interest in view of the finding that SES is related to ten-month developmental scores for fullterm and preterm but not SFD groups. Taken together these results would suggest the comparative insensitivity of the SFD infants to some aspects of the environment in the first year, though this suggestion is tempered by the questionable validity of the Flint scale.

The negative relationship between maternal responsiveness and scores on the Flint scale invites three possible explanations.

First, it is possible though unlikely that maternal responding to infant signals is incompatible with infant security. Second, the variable called "Mother response" may not reflect maternal responsiveness. It was derived from observations of interaction sequences which were clearly directional at six months and which were initiated by the infant. Only when observers were sure of the direction was this category scored, so there is a margin of underestimation which might have introduced error. Furthermore maternal responsiveness has many facets, both verbal and non verbal, and this variable alone is insufficiently subtle to provide an accurate assessment.

The third possibility is that the Flint scale is not measuring infant security, and in view of these results and the cautions mentioned earlier, this explanation cannot be ruled out. The findings in this section are therefore of limited value.

APPENDIX 6

TWIN-SINGLETON DIFFERENCES

In the main body of this thesis twin (encompassing twins and one set of triplets) singleton differences are reported in Tables 7 and 23 for interaction variables. In addition twin-singleton differences were investigated for sleep state parameters, birthweight, Apgar scores, gestational age, perception inventory scores, and four and ten month developmental assessments. Of these the only significant differences were in favour of the twins, and were for maternal perception ($t = 1.647$ $p = .2$ two-tailed t-test), and ten-month MDI scores ($t = 1.62$ $p = .2$ two-tailed t test).

Summarising the interactive differences, at two months in comparison with singletons twins looked at their mothers more, had lower rates of state change, and interacted with maternal looking and vocalising more; their dyads were more synchronised and had higher levels of mutual gaze, and their mothers differentiated waking states more frequently. At six months twins looked at objects and the observer more often, their mothers smiled, showed affection, and interacted with their play more often, and their dyads had lower levels of mutual interaction.

One of the two-month variables (waking state differentiation) and three of the six-month variables (interaction levels including and excluding fuss, and maternal interaction with play) were correlated with ten-month development in the preterm group. In each case the levels for the twins were optimal for development, in which they were significantly ahead of the singletons. One could argue that because their intellectual status was better (their advantage over singletons just missed significance at four months) they invited more optimal patterns of interaction. This view is supported by the higher levels of maternal perception in the neonatal level for twins, which in the preterm group predicted lower dyadic stimulation at six months and better intellectual performance at ten months. However the circumstances surrounding the early months of twins invites an alternative explanation, in view of the relationships found in this study among six month interaction variables and development. An adverse factor in development at three and six months for preterm infants was direct maternal stimulation; presumably the impact of this would be diluted for twins and triplets. Circumstances would encourage these infants to attend to other aspects of the environment because of the constant presence and activity of a sibling. They would also encourage a mother of twins to stimulate her infants to play in order to decrease the multiple demands upon her attention. All of these aspects of interaction were linked with high levels of development in preterm infants.

McDiarmid and Silva (1979) compared 24 twins with 1013 singletons at three years and found that the twins were three months slower in receptive and expressive language development. Comparison of the same twins with a singleton group matched on perinatal factors indicated that development at three years was not delayed, indicating that perinatal rather than postnatal factors were more likely to affect development adversely. Perinatal factors in this study were almost identical for twins and singletons in the preterm group and although the scope of developmental assessment is limited, the twins not only performed better than the singletons but there was also no significant difference between group developmental scores for twins and the fullterm group at ten months. (Fullterm group $\overline{X}$ = 117.9; SD 19.8; preterm group $\overline{X}$ = 107.6; SD 19.7).

The possibility that maternal factors such as perception and interactive behaviour might be at least partial influences on favourable outcome is supported in an investigation by Field, Walden, Widmayer and Greenberg (1982) who found that the low birthweight twin of discordant twin pairs performed better at one year than other term and preterm discordant and nondiscordant twins, despite comparatively adverse ratings on neonatal measures. In the preterm group discordant twins received more favourable ratings from their mothers and more maternal stimulation in floor-play interaction. Field _et al_ suggest that mothers supplied compensatory treatment for the perceivably smaller, frailer twin which generalised to both twins, and that

> "early risk factors for singletons, such as preterm delivery and low birthweight may not generalise to twins, and that developmental outcomes predicted by early risk factors may be reversed by unplanned treatments." (p 153)

In the present investigation the twin numbers were too small to compare discordant with nondiscordant pairs. However it is of interest anecdotally that ten-month development scores of the triplets were ranked inversely to their birthweights, as was maternal interaction with play.

It is possible then that the differences Field et al noted between discordant and nondiscordant twins also apply between preterm singletons and preterm twins. The depressing effects of preterm birth on maternal perception might be mitigated by the fact of producing more than one intact infant, so that positive maternal perception and the absence of direct overstimulation in interaction combine to make development in preterm twins more optimal than in preterm singletons, at least in the first year.